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SCIENTIFIC MEN IN WAR-TIME

Strategy

FROM the outbreak of war in 1939—and indeed for a long time previously—it was obvious that the knowledge possessed by scientific men and engineers would be of decisive importance in the coming struggle. Means had to be found of making this knowledge available, and to this end the Central Register was formed. As is well known, the Register is intended to be a complete and up-to-date record of the qualifications, experience and present employment of scientific and professional men throughout the country. There have been criticisms of the extent to which it has been used, but nevertheless it must be recognized, from the figures that have been published from time to time, that it has served a valuable purpose in filling numerous posts where the special knowledge or aptitude of scientific men has been of direct service in the war effort.

As regards the senior men of science, many of them were quickly absorbed in a number of advisory committees attached to Government departments. This was, of course, no more than a development of the peace-time practice of using scientific consultants. Advice was sought and given on specific points, but it rested with officials and Ministers, often men with little appreciation of scientific developments, to decide policy and take action. The position was somewhat better where there were influential advisory councils consisting of departmental scientific advisers and eminent men of science from outside the Government service. Some of these bodies were appointed a good many years before the War, and have given valuable guidance; among them may be mentioned the Advisory Council of the Department of Scientific and Industrial Research, the Medical Research Council, the Agricultural Research Council and the Aeronautical Research Committee. Among the war-time bodies of this character are the Civil Defence Research Committee, serving the Ministry of Home Security, and the Council for Scientific Research and Technical Development, serving the Ministry of Supply.

Still scientific men and their representative bodies had no direct voice in the formulation of policy. This defect was to some extent remedied by the formation of the War Cabinet Scientific Advisory Committee, composed of six eminent men of science, three of whom are Government servants and the other three the president and two secretaries of the Royal Society, thus preserving a balance between departmental and outside interests. The Committee, under the chairmanship first of Lord Hankey and now of Mr. R. A. Butler, reports direct to the Cabinet. A similar body under the same chairman, the Advisory Committee on Engineering, has analogous functions.

So much for the organization of scientific effort and for the means which have been adopted to ensure that sources of scientific and technical knowledge are at the country's service. But as Sir Henry Tizard pointed out in an address to the Parliamentary and Scientific Committee early this year, there are both tactics and strategy in the application of science.

Broadly speaking, the Scientific Advisory Committee, and the Advisory Committee on Engineering, with their numerous outside contacts, can exert an influence on the strategy of science; the Central Register and various departmental committees look after recruitment and tactics.

The next step is to examine the means adopted for translating strategy into action. The crux of the matter seems to be the system whereby the administrative side of Government departments exerts a disproportionate influence on the course of events. A great improvement in departmental outlook has resulted from the appointment of strong advisory councils including independent as well as departmental scientific and technical officers. The Air Ministry had long availed itself of external scientific advice, and the Ministry of Supply—which took over the scientific functions of the War Office—did the same through its Scientific Advisory Council and committees. By such means contact with the outside scientific world was ensured for their full-time workers. The Ministry of Aircraft Production took over in 1940 the scientific functions of the Air Ministry, but Sir Henry Tizard, rector of the Imperial College of Science and Technology, is a member of the Air Council as well as of that of the Ministry of Aircraft Production, and in the War Office Sir Charles Darwin has recently been appointed scientific adviser to the Army Council.

The position in the Admiralty is not so good. The Admiralty has maintained a Scientific Research and Experiment Department for many years, but its director has not the collaboration of an advisory council containing experienced outside scientific men, and the workers in Admiralty scientific establishments are far more isolated than elsewhere. Matters are improving, for a panel was appointed a little more than a year ago, containing two external scientific members, to examine the working of Admiralty establishments; and recently a group has been appointed to conduct operational research in connexion with the Naval Staff.

Although such advisory councils have done invaluable work, there is ample evidence of continued dissatisfaction with the rate of application of scientific and technical knowledge and development in the national war effort. The Association of Scientific Workers has been investigating alleged misuse of man-power and materials, and its findings are being forwarded to the Ministries of Labour and Supply, and there have been numerous suggestions in the Press for the more efficient utilization of the excellent scientific and technical resources of the country, including a revival of the suggestion for a Ministry of Science. A vigorous letter from Prof. A. V. Hill dealing with the importance of scientific and technical guidance in the highest circles of government was published in *The Times* of July 1, and succeeding correspondence has shown that his proposals have provoked wide interest. Prof. Hill says that many of our disappointments and failures to match Axis moves in the past have been due to technical mismanagement, in the sense that there has been neglect to anticipate future requirements and to profit by operational experience. The Chiefs of Staffs organization deals with operations, the Ministry of Production deals with supply; but there is no comparable body to advise the Cabinet or the Chiefs of Staffs directly on scientific or technical aspects of either operations or supply. Such a body is necessary to guide those who are directing the strategy of the present conflict. He then describes in outline the organization which has been adopted in the United States. A year ago an office for Scientific Research and Development was established under the chairmanship of Dr. V. Bush, formerly of the Massachusetts Institute of Technology, with three departments: the National Defense Research Committee (under Dr. J. B. Conant) to deal with research and development of weapons; the National Advisory Committee on Aeronautics (under Prof. J. C. Hunsaker); and the Committee on Medical Research (under Prof. A. N. Richards). This body reports direct to the President. Recently a Joint Committee on New Weapons and Equipment, consisting of Dr. Bush (chairman), one technical staff officer from the Army and another from the Navy, has been appointed, with executive authority, to work with the American Chiefs of Staffs organization, advising on technical, engineering and scientific matters, and guiding research and development in the interests of the Fighting Services.

The formation of a small body with similar powers and similar qualifications is long overdue in Great Britain. A committee or council so constituted, with high authority and direct access to the innermost councils of the State, and including adequate independent scientific and technical opinion, would be in a position to supervise the whole range of research and development coming within its field of knowledge, and to provide the co-ordination and cohesion necessary in waging a war in which the machine element plays so large a part.

Tactics

Strategy and tactics in the application of scientific developments both fail if the individual men of science are unable, for any reason, to respond to the calls made on them. To pursue the military analogy, they must keep 'fighting fit'; their minds must be fresh, active and responsive, and their knowledge must be up to date. In normal times, scientific men working in university or similar laboratories have the continuous stimulus of contact with other men engaged in diverse work, both inside and outside their own field of study; many of them spend a certain amount of time in teaching. They are members of learned and professional bodies through which the relevant literature is made available and meetings for discussions are arranged. In short, there is every facility for maintaining contact with the progress of thought in a selected field, and also with the everyday world. Workers in industrial laboratories are perhaps not quite so fortunate, in that trade 'secrets' have to be borne in mind, and they may not feel quite so free to speak in discussions. Nevertheless, it will be conceded that industrialists in general realize that research workers must be given latitude

in this matter, and they usually encourage them to keep up their scientific contacts.

Scientific men in Government service are in many cases on a very different footing. In certain laboratories and establishments, notably those working under the three research councils (Department of Scientific and Industrial Research, Medical Research Council and Agricultural Research Council), they are, for the most part, almost as unfettered as are research workers in a university. Their work is usually published through the ordinary channels, and is submitted to discussion both by their own colleagues and by outside independent scientific workers. In other departments, particularly those attached to the Fighting Services, conditions of secrecy impose restrictions. It must be recognized that many of the investigations undertaken by such departments cannot be divulged, but because this is so, it does not follow that every investigation is a sealed project, and that the unfortunate individual or individuals to whom it is allotted should retire into monastic seclusion, separating themselves from their scientific brethren. Indeed by so doing, they cut themselves off from the fertilizing influence of discussion and criticism, and the quality of their work suffers accordingly. In time of war, the position is aggravated, and there is the very real danger of the administrative element taking alarm and decreeing that all work carried out in the department is secret. The proper course is to acknowledge frankly the limitations imposed by the nature of the work, and take appropriate steps to mitigate their effect.

Scientific workers in Government departments have indeed to meet special difficulties. There is grave danger of stagnation, and senior men may easily tend to become officials rather than working men of science. It is not sufficient to have a permanent scientific staff, supplemented during war-time by leading scientific workers, together with a number of temporary juniors, and to supply them with equipment and literature; they cannot develop their powers to the full in isolation. Yet this is the position in some Government Departments. It is only a reasonable precaution, at which none will cavil, that those in Government service should be expected to obtain official permission to carry on outside scientific activities; but in practice they may be actively discouraged from maintaining their contacts with the world of science.

There have been many suggestions in the past few years for improving the lot, and the efficiency, of scientific workers in Government service. The appointment of scientific advisory councils including independent scientific men, to survey progress and development in the various Departments of State, could scarcely fail to have beneficial effects. One of the first would no doubt be diminished isolation of the scientific men, particularly the younger ones, with a resulting improvement in the quality of their services to the nation. The criticism of their colleagues plays an important part in developing and maintaining at a high level the powers of scientific workers; it is an essential part of their equipment, the importance of which increases with their responsibilities.

FORMATION OF THE GANGES DELTA

Deltaic Formation

With Special Reference to the Hydrographic Processes of the Ganges and the Brahmaputra. By Prof. C. Strickland. Pp. xvi+157. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 9s.

WHETHER one judges by length of sea face or by distance from the apex, the combined delta of the Ganges and Brahmaputra is the largest in the world, which gives it an importance not lessened by its density of population, and its length of known history. Consequently the appearance of a work dealing comprehensively with its mode of formation and continued modification is of importance not only to geologists, but also to engineers, administrators, and medical men, and to all others who have to deal practically with the working and changes of deltaic rivers.

Much has been written in the past on various aspects of the combined delta of these two rivers and of their history as a whole, the two most important works being James Fergusson's classic paper "On Recent Changes in the Delta of the Ganges"[1], and Chapter 17, on the "Indo-Gangetic Plain", of the second edition of Medlicott and Blanford's "Manual of the Geology of India", as revised by R. D. Oldham in 1893. Fergusson is one of those rare men who have produced classics in two branches of knowledge, the other being his "History of Indian and Eastern Architecture"; and both his classics still hold the field to the present day as the most important works in their respective spheres.

No detailed or even continuous geological survey of the Ganges-Brahmaputra delta has ever been attempted owing to the paucity of geologists in India compared with the tasks; but certain of the major aspects of the Indo-Gangetic river system including the deltas have been dealt with by geologists, while some of the more detailed aspects of the Ganges-Brahmaputra delta have been discussed from time to time by settlement officers, and by engineers concerned with irrigation, drainage and river training; further, of recent years, gravity observations by the Geodetic Branch of the Survey of India, and by the staff of the Burmah Oil Company, have led to the acquisition of knowledge, not all of it published, concerning the configuration of the basement upon which the delta rests.

It is timely, therefore, that some one should attempt to synthesize the growing knowledge on this delta, especially one who has had abundant opportunity to make personal observations on the behaviour of rivers in deltaic tracts as an adjunct to his own professional work. For Dr. C. Strickland, who is a member of the professorial staff of the School of Tropical Medicine, Calcutta, has had occasion, in his medical capacity as a research worker on problems connected with the causes and prevention of malaria, to travel far and wide, not only in Bengal and Assam, but also in Burma and Malaya, and elsewhere; like Fergusson he has made full use of his opportunities to observe the detailed behaviour of deltaic rivers.

In his book the author devotes the first twenty-six chapters to the discussion of the hydrographic processes at work in the Ganges and Brahmaputra, assuming the rock basement on which the alluvium

rests to be static, and reserving for a final chapter "the influence of diastrophism of the earth's crust on the hydrographic processes". The author has recognized the important geologist's separation of the alluvial deposits into 'older alluvium' and 'newer alluvium', the older alluvium being now subject to denudation and the newer alluvium still in course of deposition, either in channels in the older alluvium or on land newly won from the sea; but he prefers to describe these respectively as 'paradeltaic' and 'deltaic' deposits. This has really involved a redefinition of the term 'delta', and leads to the confusing result that patches and streaks of 'paradelta' may be mixed up with or surrounded by the 'delta', while strips of 'paradelta' are found right into the Himalaya. To me it seems preferable to retain the customary use of the word 'delta', recalling that it takes its name from the triangular shape of the Greek capital letter, and that a delta commences at the point where a river begins to divide into distributaries, this point being the apex of the delta. The deltaic tract, on this usage, then consists of portions that were formed in the past and may now be undergoing erosion, and portions where active deposition is still taking place. However, Dr. Strickland's use of the term 'paradelta' does not spoil comprehension of his work. If adjectives are required to describe the older and newer deltaic deposits, would not *palæodeltaic* and *neodeltaic* be suitable?

The main thesis of this book is that all the changes observed in a delta can be explained purely on a hydrographic basis without invoking the aid of diastrophic processes. Thus the fact that there is a belt of low-lying land occupied by numerous swamps, with *bhils* or *jhils* of water, stretching continuously from near Calcutta eastwards through the districts of Jessore, Faridpur and Backergunge, as indicated on Fergusson's map, and separated from the sea face to the south by a belt of higher land, is not, according to Dr. Strickland, due to a diastrophic depression of the swamp belt, as some engineers and settlement officers have urged, but to the elevation of the seaward belt by deposition from the distributaries of the delta, as is accepted by geologists. Also Dr. Strickland holds that such elevated tracts as the well-known Madhupur Jungle north of Dacca are merely residua of denudation and do not owe their existence to tectonic uplift. In this he disagrees with Fergusson[1] and Oldham, and is perhaps unaware that Colonel Glennie, of the Survey of India, has recently shown by means of gravity determinations that there is a minor 'up-warp' under the Madhupur Jungle.

Dr. Strickland is working on sound lines in explaining as much as he can on a purely hydrographic basis, drawing his deductions from phenomena that are observable at the surface; but it must be recalled that the deltaic tract of the Ganges and Brahmaputra is tectonically very unstable, as is shown by the frequency of earthquakes, which in some cases, especially towards Assam, have produced results observable at the surface, as described in the relevant Memoirs of the Geological Survey of India.

Moreover, while anyone who studies the geological and orographic data can accept the view that the Brahmaputra and Ganges were once parts of a river flowing westwards to join the Indus system (Pascoe's "Indobrahm" and Pilgrim's "Siwalik River") and separated from the Bay of Bengal by a ridge of land joining the north-east corner of the Peninsula to the Assam Plateau; and that this ridge has since been breached, so that a southward-flowing river or rivers (for example, the ancestor of the Bhagirathi and Hooghly) debouching into the Bay of Bengal could cut back by head erosion and tap the Indobrahm, it does not follow that this was achieved by head erosion alone. It seems to me that diastrophic processes must also have taken a hand, and that this breach through which the Ganges and Brahmaputra now flow south is partly the result of down-faulting. According to the gravity results of the Survey of India[2] there is still an axis of 'up-warp' (by which is presumably meant a belt of rock denser than that to the north and south) connecting Bihar and Assam under the Ganges-Brahmaputra alluvium. As the back of this axis of rock, however shallow the alluvium may there be, lies presumably below sea-level, it cannot have been lowered by river erosion, and must have been thrown down by tectonic movement.

Further, as the alluvium under Calcutta is known from borings to be at least 1,306 ft. deep[3] (and is possibly several thousand feet thick), and is composed of freshwater and estuarine sediments that were all deposited at or close to sea-level, the rock floor beneath the Ganges delta must have sunk by 1,300 or more feet, due either to the growing load of sediment (then an isostatic adjustment), or to direct diastrophic movement; consequently it is impossible to exclude causes other than hydrographic from the general discussion, although all surface details can be explained in terms of deposition and erosion due to hydrographic processes, as is done so lucidly by Dr. Strickland. Once the necessity of admitting the action of diastrophic processes at least at intervals is recognized, one must admit also the possibility that the Madhupur Jungle and other elevated tracts of older alluvium owe their present elevation to uplift.

Every student of river processes is recommended to study Dr. Strickland's work, wherein he will find a full discussion of the processes by which new land is won from the sea, of the formation of lagoons or *bhils* of various types and of islands (*dwips*), of the embankment of rivers, of the conflict between the transporting action of rivers and the influence of tidal waters, and of the gradual death of many deltaic river channels. In reading this book, however, he will find it necessary to make periodic reference to a dictionary, because the author uses many uncommon words, or gives them unusual meanings, such as "appose" and its derivatives, "occlude" and its derivatives, "declivity", and "infinitesimally great"; or uses words that do not appear to have dictionary sanction, such as "alluviation", "diluviation", "siltation"; while the word "height" is consistently spelt with a final "h". But these difficulties are alleviated (or shall we say "alluviated"?) by a racy style and free use of happy metaphor, as in the following quotation, which illustrates the spirit of the book (p. 4): "Therefore no alluvial deposit has any 'divine right' to permanency, simply because it was once thrown down by a 'wet nurse' who could bear the burden no longer."

L. L. FERMOR.

[1] *Quart. J. Geol. Soc.*, **19**, 321–54 (1863).

[2] Geodetic Report, Survey of India 1937, Chart IX.

[3] See Dr. A. L. Coulson's "The Geology and Underground Water-Supply of Calcutta, Bengal, with special reference to Tube-Wells", *Mem. Geol. Surv. Ind.*, **76**, 24 (1940). This work is contemporary with Dr. Strickland's book, and neither author appears to be aware of the other's work. Chapter 2 of Dr. Coulson's memoir gives an excellent summary of previous work on the "Early History of the Ganges and the Formation of the Ganges Delta".

A PHILOSOPHY OF THE UNIVERSE

Design and Purpose

By Prof. Frederic Wood Jones. Pp. 84. (London: Kegan Paul and Co., Ltd., 1942.) 5*s*. net.

IN this little book, an expanded version of his Purser Lecture at Trinity College, Dublin, Prof. Wood Jones expresses his general philosophical convictions. The whole universe, he argues, forms one system, a chain of being including both the animate and the inanimate. Man has his place in the system along with all other creatures and is in no way apart from or above it. The system is not to be considered as a mechanical aggregate but as exhibiting design throughout and as the sphere of purposive action; as, in fact, the outcome of the creative purpose of the cosmic mind. The author invokes, in support of his view, the animism attributed to primitive man, the systems of Buddha and Lao Tze, and also of Plato and Aristotle—rather a mixed bag of authorities.

What is more surprising is that Prof. Wood Jones also invokes the support of Paley. For Paley surely, like practically all those of his time, was arguing for a purely mechanical universe in which living organisms were just more elaborate and automatic machinery, and all was designed and run by the Great Artificer. It may be granted at once that Paley was more clear-sighted than many of the Darwinians of a later day who supposed that automatic machinery could somehow design, produce and run itself by pure luck, coupled with the blessed word 'evolution'. Still Paley stands for two doctrines that are otherwise anathema to Prof. Wood Jones. As to the first, Paley's system was not conceived in terms of a theory of pantheism or of a purely immanent world spirit, such as Prof. Wood Jones approves, but in terms of a personal and transcendent deity. That is a view that Prof. Wood Jones attacks fiercely, seeing nothing in it but an unfortunate survival of the tribal god of the ancient Hebrews. Clearly you can have either a mechanical world run by a transcendent mechanic or the world as organism animated by a world soul. By itself each is a reasonable view, but the two are not easy to reconcile; certainly the advocate of one can scarcely claim the support of the advocate of the other.

The second difference is that Paley, necessarily as a Christian, held that the human soul is in some way separate, distinct from and above the material and mechanical world. Plato also held this view, though he did not believe in a mechanical universe. For Prof. Wood Jones such a theory savours of false pretensions and arrogance. There is a very dangerous kind of humanism which puts man above Nature, and it has been very prevalent since the Renaissance. Against this his attack is well and properly directed, but it has nothing to do with Christian or Platonic theories about the soul, which are perfectly compatible with his view, and which I believe he misunderstands. His point may be put quite simply. Analytic, sophisticated urban thinkers tend to imagine man as something separate from his environment, superior to it and therefore entitled to interfere with other creatures to make them serve his own ends. A true appreciation of the facts comes easily to man living under primitive conditions. The facts were clearly seen by synthetically minded thinkers of earlier times. The same lesson can, however, be equally well learnt from biological science when the view of the whole is not obscured by partial views of mere specialists. If we realize that organism and environment are inseparable and each adapted to the other, that men like all other creatures have a part to play in a cosmic purpose greater than any individual, then we are likely to take a humbler and more balanced view of ourselves. This is worth saying. In this connexion Prof. Wood Jones does well to remind us of Samuel Butler, even though Butler's biology was not always very sound. It is true that science in the strict sense can tell us nothing about a cosmic (or any other) purpose; it is a metaphysical notion. It is also true that if there is no kind of cosmic purpose, then the purposes of individual human beings are futile.

A. D. RITCHIE.

ECONOMIC FORCES AND WORLD ORDER

The Economics of 1960

By Colin Clark. Pp. x+118. (London: Macmillan and Co., Ltd., 1942.) 8*s*. 6*d*. net.

MR. COLIN CLARK is easily the most daring of statisticians. We have known since he published his "Conditions of Economic Progress" that there is almost no degree of inadequacy in the data that is enough to deter him from arriving at some sort of a quantitative conclusion, however provisional it has to be. In his new book he applies to the future the methods he has made his own in handling the present and the past. His general thesis is that the course of economic development over the next two decades will probably be affected very little by political events. War may retard the processes of growth, but will scarcely alter their character; and changes in social system and class structure can also be disregarded in measuring the probable movements of the world's economic life. In the past, Mr. Clark maintains, wars and revolutions have been unable to override fundamental economic forces; and we and our children are likely to find it so again.

To be sure, Mr. Clark postulates, for the purpose of his prophecies, a world not dominated by economic nationalism, and a freedom for the exchange of commodities and services in marked contrast to the tendencies of the past twenty years. But he seems to think that this freedom will be forced on the world by economic forces, whatever politicians may plan. His thesis is that historically economic development reveals an alternation of 'capital-sated' and 'capital-hungry' periods, and that, after a period of satiety, the world is due to pass into a period of capital-hunger which will be intensified by war-destruction. He therefore looks forward to a very active resumption of international investment, accompanied by, and indeed involving, a big shift away from primary production to manufacturing and service industries, as well as a sharp alteration in the 'terms of trade' in favour of primary producers as against manufacturers.

These shifts, he believes, will be part of a process which will add immensely to the world's total wealth and especially to the productivity and income of the countries which are behindhand in economic development. He expects China, India, Eastern Europe and other backward areas to absorb huge masses of capital and, while becoming industrialized, to become at the same time greatly improved markets for the consumers' goods as well as for the capital goods of the already developed countries. He expects not only the United States, but also the U.S.S.R., to

become a large net importer of foodstuffs and other agricultural products, and advances notions which are at first sight startling about the economic future of many other areas. His arguments are backed up by the clear demonstration that the immense changes which he confidently predicts are no bigger than the changes which actually occurred during the nineteenth century under the impact of the Industrial Revolution.

A large part of Mr. Clark's book is statistical; and many of his calculations refer back to his "Conditions of Economic Progress", and cannot be fully understood without looking up the relevant passages of that work. Indeed, "The Economics of 1960" is in form a sort of forward-looking postscript to his "Conditions"; and critics who were sceptical of Mr. Clark's methods in the main book are likely to be no less sceptical now. I confess, myself, to a certain degree of scepticism, combined with a conviction that Mr. Clark is essentially right. I do not believe in many of his figures; but I do believe that he is correctly predicting the trends, if not their absolute or relative strength. There can be no doubt either that the world is ripe for a vast new adventure in international capital development, based mainly on the rapid industrialization of Eastern Europe, Asia, and parts of Africa, or that this new phase of growth requires a politico-economic setting of unrestricted, though not necessarily unregulated, foreign trade. If the political settlement after the War is of such a character as to frustrate the exchange of goods and services, there will be a terrific conflict between the forces sustaining the settlement and the forces making for a world crusade against poverty and unemployment. Mr. Clark seems to be entirely confident that in this struggle the forces of unreason would get the worst of it. I sincerely hope they would; but I am not so sure—and I am still less sure that the basic economic forces will win quickly enough for all the gains Mr. Clark has in mind to have been safely garnered by 1960.

I am therefore disposed to accept this statistical pamphlet less as an essay in prophecy than as a pointer towards a sane world economic policy. For I think Mr. Clark has been able to show quite conclusively that the world can, if it behaves itself with ordinary common sense, be by 1960 immensely more prosperous than it has ever been, and that too with a prosperity shared in by most of the human race. Regarded in this way, Mr. Clark is a powerful ally of Mr. Roosevelt, Mr. Wallace, and other American spokesmen of the age of plenty, and a formidable critic of the economic restrictionism which has been so terrifyingly enshrined in recent pronouncements of the Federation of British Industries and other representative organizations of British capitalism. Certainly, if these apostles of monopoly get their way, Mr. Clark's predictions will not be verified. Rational division of labour between areas will be prevented; international investment will not revive; there will be mass-unemployment as there was in the 'thirties, and probably yet more and more devastating war. Mr. Clark, I think, will agree to this, but will reply, more confidently than I can, that the restrictionists will not get their way, and that, war or no war, the underlying forces making for economic progress will get theirs. I am not so sure as he is that our civilization is indestructible by human folly. But I earnestly hope that he is right; and I welcome his book as a most cogent dramatization of what mankind is in a position to accomplish in the economic sphere, if mankind but will. G. D. H. COLE.

A POPULAR INDEX TO COLOUR

Horticultural Colour Chart

Vol. 2. Issued by the British Colour Council in collaboration with the Royal Horticultural Society. 100 plates. (London: Royal Horticultural Society, 1942.) 12*s*. 6*d*. to Fellows of the Society; 22*s*. to non-Fellows.

AN abnormal three years have intervened between the publication of the first volume of the Horticultural Colour Chart (reviewed in NATURE of March 11, 1939) and the recent appearance of the second volume, and the publishers are to be congratulated on the foresight which led them to reserve the art paper and other materials required to ensure uniformity of make-up.

Thirty-four of the new sheets show lighter tints, twenty-eight selected darker shades, and the remaining thirty-eight plates are taken up with hues greyed to a lesser or greater degree. (Twenty-six sheets of the first volume represented paler tints, and ten darker shades, of certain of the sixty-four full hues.) The extent to which the brightness or purity of the full hue is modified is indicated by an appropriate prefix to the sheet reference number of the unmodified colour. A complete series on these lines would require a great number of sheets, and convenience and cost alike demand a reduction to more manageable proportions by selection of the most useful modified or supplementary colours. The publishers imply, although they do not specifically state, that this second volume is final.

A random selection of flowers picked during March–June showed the chart as a whole quite efficient in providing close colour matches. It fails in some cases. Many Polyanthus have flowers outside its range, particularly in dark shades; Viola and other genera, including dark and velvety-textured flowers, discover the same lack of matching sheets. The bluest primroses would require the appropriate hues to be twice or thriced greyed in the scheme of the chart, whereas they are only represented once greyed, if at all. By a process of imaginative intercalation or extension such gaps can be filled, and a non-existent sheet number quoted as a guide to the required colour, if not as a certain match. Browns are ill-represented. This weakness is perhaps not important where flower colour is concerned, although it will be noticed, for example, in connexion with Fritillaria; but greater curtailment of the usefulness of the chart in other spheres will result.

The "horticultural examples" given on the sheets are not always happily chosen. The flowers of *Aquilegia vulgaris* as a wild plant vary considerably in hue, and in the garden show a whole gamut of colours of which the "aconite violet" singled out for quotation is doubtfully the commonest. Similarly injudicious references are *Saxifraga oppositifolia*, *Primula denticulata*, *Dianthus barbatus*, and *Geranium sanguineum*.

The most serious faults of the chart were already obvious in the first volume. There is considerable but inconstant overlap between tones of the same hue on different sheets; 928, for example, appears quite redundant, as 828 and 1028 form a continuous series without appreciable break; the range of colour on 403, 503 and 603 could comfortably be accommodated on a single sheet. If this kind of duplication had been avoided the same number of two hundred plates could have covered most of the omissions mentioned above.

A common lilac (*Syringa vulgaris*) is placeable with equal propriety against 437 or 537/2; but its colour would accordingly require naming pastel lilac or (pale) mauvette. In the same way *Scilla bifolia* may be (pale) gentian blue or flax blue. Quite apart from the alternative classifications made possible in this way, unrelated colour names within the confines of a single hue are a mistake. If independent names had been restricted to the sixty-four full hues (relaxing this rule in favour of brown and pure grey), and, to take a set at random, sheets 622, 22, 022, 0022, 722, 822 had been named pale crimson (or crimson pink), crimson, dull crimson, grey crimson, rich crimson, deep crimson, instead of camellia rose, crimson, rose opal, rhodonite red, cherry and cardinal red, not only would relationships have been made obvious, and despite overlapping, serious ambiguity avoided, but also actual use of colour names in a uniform sense would have received far more encouragement than will be given by the chart in its present form. Utility has been sacrificed on the altar of 'historical interest', and the best possible use not made of good work.

For the chart itself is good work. Perfection has not been attained, of course; the tone intervals are not constant in the treatment of different hues, and changes in intensity (purity or saturation) occur where nominally only a tone difference exists. But obvious fault is very rare, and the ink makers and printers are to be congratulated on a fine technical achievement.

SAMPSON CLAY.

SOME ASPECTS OF PHYSICS

Reports on Progress in Physics
Vol. 8 (1941). General Editor: W. B. Mann. Pp. iv+372. (London: The Physical Society, 1942.) 25*s*. net.

THE years since the outbreak of war have seen an unprecedented increase in the number of men actively engaged on research in physics, using the word 'research' in the sense of the application of the principles of physics to the solution of urgent practical problems. New research establishments have been created, old ones greatly extended, and students are being rushed through universities and technical institutions to give a hand with the work, or to service the inventions which have already reached the stage of production. That this expenditure of energy and ingenuity is not going unrewarded is well known, though, for obvious reasons, nothing of this activity can yet find its way into "Reports on Progress in Physics", the eighth volume of which (1941) is now to hand. When the time comes to raise the veil of secrecy which now necessarily hides the war-time activities of physicists from the common gaze, the editor of these Reports will be in for a good time: for it can scarcely be doubted that much of permanent interest will emerge from these *ad hoc* investigations. In the meantime he undoubtedly has his troubles. Not only has fundamental research been replaced by war-time activities, but also likely authors are too preoccupied to report even on immediate pre-war discoveries. That, in the circumstances, the new volume should have appeared so promptly, and, in appearance and format so like its elegant predecessors is an achievement on which the Physical Society, and the new general editor, Dr. W. B. Mann, may be sincerely congratulated. That, in addition, it should contain three or four reports of real interest is an uncovenanted mercy for which we may be duly thankful.

For this admirable result the editor is much indebted to the generous help of American physicists, who have contributed more than half the text, and considerably more than half the interest of the volume. At the time when the reports were planned the shadow of war had not actually engulfed the United States, though it was obviously approaching fast. Physicists there had just time for one further look round the laboratory before taking off their coats and settling down to the job; and they have certainly made the most of the opportunity. That they should, as the editor records, have also requested that the honoraria attached to the reports should be given to some suitable fund in Great Britain is only one further example of the large-hearted sympathy which American men of science have so consistently shown towards us throughout our struggle. We shall not easily forget it.

To present a completely impartial account of a collection of fourteen separate reports on a wide variety of topics is probably beyond the power of a human physicist; no doubt some ingenious combination of photo-cells and electronic valves will ultimately be designed to do the job. In the meantime judgment is certainly influenced by personal interest in the subject-matter of the report. In particular, a wide and ever-widening chasm seems to be opening up between the experimental and the theoretical physicist. Much as we may agree with Prof. Born (whose article on the "Teaching of Theoretical Physics" opens the volume) that "the separation of one single science, physics, into two parts which differ, not with respect to the object but with respect to the method" is particularly regrettable, it must be confessed that neither party is much interested in the other's technique, and that neither the language nor the modes of thought of the theoretical physicist are easily comprehended by his experimental colleagues. To ask that the theoretical physicist should write for the benefit of the experimentalist would be to deprive his report of much of its intrinsic value. A subject which, to quote Prof. Born again, requires only "paper, ink, pen, a few books, and a calculating machine" is likely to be popular in the days of austerity after the War; unless, of course, one of the 'planning' committees for which some of our enthusiasts are pressing should decide that the subject is anti-social, and order its suppression. May we offer the suggestion that, when times become easier, the Physical Society might consider the possibility of issuing separate Progress Reports on the two aspects of our vast subject; employing some specially gifted person—Prof. G. Gamow could do it—to report to the experimental physicist as much as he needed to know of the contents of the theoretical volume.

Descending from the general to the particular, every physicist will be glad to have at hand Raymond T. Birge's latest report on the "General Physical Constants", and the tabular results of his latest survey of this fundamentally important subject. Incidentally we may hope that the powers that be (if there be any "powers" in physics) will take note of the fact that, owing to the coexistence of international coulombs, absolute coulombs, a chemical scale of atomic weights and a physical scale of atomic

weights, Birge finds it necessary to give four different values for the Faraday constant, and decide to do something about it. George R. Harrison gives a fascinating account of the M.I.T. project for measuring and tabulating the wave-lengths of some million spectrum lines—an example of mass production in high accuracy measurement which in ingenuity and courage can bear comparison with anything achieved in industrial mass-production. J. W. Beams contributes a useful summary of advances in "High-speed Centrifuging"; and "Recent Television Developments" are dealt with by V. K. Zworykin and R. E. Shelby, of the R.C.A. and the National Broadcasting Company, New York. On the theoretical side, Robert S. Mulliken and Carol A. Rieke report on "Molecular Electronic Spectra", and Eugene P. Wigner and Eugene Feenberg discuss the "Symmetry Properties of Nuclear Levels".

It would be unreasonable to expect that all the reports in the volume should reach the level of interest of those named in the previous paragraph. R. W. Lunt, with von Engel and J. M. Meek, gives a useful summary of the present position as regards discharge phenomena in gases, leaving one with the no doubt justifiable impression that there is still a good deal to be cleared up in the subject, and A. Hunter contributes a readable account of recent improvements in instrumental technique in astrophysics. If some of the remaining contributions scarcely seem to come up to pre-war standards (and it must be admitted that one or two of them are a little weak) we must lay the blame on the times. "Reports on Progress in Physics" has established itself as the most important yearly publication in the subject. In spite of difficulties, the present volume as a whole does nothing to impair its reputation. May we wish the Society and the editor equal good fortune with Volume 9. J. A. CROWTHER.

A FATEFUL LEGACY

Darwin, Marx, Wagner

Critique of a Heritage. By Jacques Barzun. Pp. xii+420. (London: Martin Secker and Warburg, Ltd., 1942.) 15s. net.

MR. BARZUN is a historian who is especially interested in the political effects of theories of race and class conflicts. He has already published works on "The French Race" (1932), "Race: A Study in Modern Superstition" (1937), and "Human Freedom" (1939). His researches have convinced him that the terrible predicament in which mankind now finds itself is mainly the result of the influence of certain ideas set in motion by three men in the second half of the nineteenth century—including under 'influence' also reactions against them. The three thinkers in question were Darwin, Marx and Wagner. At first sight this may seem a curious combination. The author may appear to have been impressed unduly by his observation that it was in the same year (1859) that Darwin published "The Origin of Species", Marx his "Critique of Political Economy", and Wagner completed "Tristan and Isolde". Whether this was or was not a mere coincidence, Mr. Barzun makes out a plausible case for his view that, in spite of their obvious differences, the three authors expressed and popularized one and the same philosophy, namely, that of mechanistic materialism. Darwin did so in the field of natural science, Marx in that of sociology, Wagner in that of art.

The possibility of a common world view, amid their divergent specialisms, was facilitated by the fact that none of the three men stuck strictly to his last; they all spread themselves more or less widely beyond their special province. Darwin had much to say about psychology and social science; Marx exercised the privilege of a philosopher, and took all the world to task; Wagner wrote more than he composed—in fact his writings fill ten volumes, and deal with all sorts of things.

Mr. Barzun also detects some common traits in the characters of the three men. He contends that they were all rather self-centred, ungrateful to their forerunners, and ruthless to their rivals and critics. Many who would readily agree with this view of Marx and Wagner will probably demur in the case of "our gentle Darwin". Mr. Barzun, however, submits a considerable amount of evidence in support of his contention. Some of the evidence may be indicated briefly. Darwin somehow conveyed the impression that he had arrived at his conception of evolution independently of his predecessors and contemporaries, although it is known that he was acquainted with the work of Buffon, Lamarck, Malthus, and his grandfather Erasmus Darwin. The "Historical Sketch", which was first added to the third edition of "The Origin of Species", dismisses Buffon, misrepresents Lamarck, and buries Erasmus Darwin in a footnote. Yet, according to Osborn, Darwin's theory of the origin of species was really threefold, and two of these component theories were adopted from Buffon and Lamarck.

Be this as it may, Darwin's main contribution to the theory of evolution was, of course, his theory of natural selection from accidental variations. Variations favouring survival are preserved. But the variations are accidental, and the selection is natural or automatic. So the changes in living forms appear to be accounted for in a more or less mechanical way. Nature red in tooth and claw did not disgust Darwin. He could even see grandeur in this struggle for existence. "From the war of nature," he wrote, "from famine and death, the most exalted object of which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life." It was obviously easy to misapply such a view to politics. People saw grandeur in war and other forms of political and social conflict. The literature of the period 1870–1914 is one long call for blood. In almost every European country during that period there was a war party demanding armaments, an individualist party demanding ruthless competition, an imperialist party demanding a free hand over backward peoples, a socialist party demanding power, and a racialist or nationalist party demanding purges of aliens. Of course, Darwin would not have approved of such applications of his view. In fact, he soon began to have doubts about the efficacy of natural selection even among races of pigeons, let alone races of men. But ideas once set in motion soon get out of the control of the originator, and continue to be misapplied by unscrupulous opportunists in ways that sometimes make science a source of mortal danger to mankind.

Marx regarded himself as the Darwin of sociology.

He wanted to dedicate his "Capital" to Darwin, who, however, declined the honour without interest. Social development appeared to Marx to be essentially similar to natural evolution. Both are determined by material factors; and the individual does not count in either case, only the class. The material factors in the case of the social group are the natural resources, modes of manufacture, means of communication, etc., which constitute the social environment; and the social struggle for existence takes the form of a conflict of classes, through which progress is achieved. Marx, however, was not content to leave things to 'natural selection'. He resorted to fierce propaganda, fanatical agitation, and ended as the "Machiavelli of the working class movement".

Of the three characters who occupy Mr. Barzun's stage, Wagner was undoubtedly the most mischievous. He was selfish and opportunist in the highest degree; and as a born actor he managed to appear better and wiser than he was. His music-dramas, like his life, are mainly concerned with fighting, deception and adultery; and his use of old pagan legends and a creed of fatalism was a device to put at least a thin veneer of respectability on the immoral. Nietzche saw through him and denounced him. The militarists, however, found in Wagner just what they wanted, especially in his "Ring", which celebrates the superman and the triumph of Germanism, in a tale of blood, lust, and deceit. Wagnerism became a widespread cult. German soldiers and politicians fancied themselves bestriding this world like the legendary gods and heroes of Wagner's stage. They were intoxicated by Wagner's art and his artfulness, and were stimulated in the pursuit of ambitions which for the second time in a generation are threatening to devastate mankind.

Mr. Barzun's book is not entirely free from mistakes or from an occasional tendency to journalism; but it contains a vivacious and competent discussion of many interesting problems, and may be recommended to all who are interested in our heritage of fateful ideas.

A. WOLF.

ENGINEERING PEDAGOGY

Engineering Mechanics

By Prof. S. Timoshenko and Prof. D. H. Young. Second edition. Pp. xiv+523. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 28*s*.

Engineering Kinematics

By Prof. Alvin Sloane. Pp. xi+310. (New York: The Macmillan Company, 1941.) 17*s*. net.

IN the training of the young engineer the teacher has to look both backwards and forwards. He has to examine carefully what has been done in the past, that his students may master the detailed technique already applied successfully in these problems. In this respect he seeks to produce young men capable of dealing with issues similar to those previously solved. On the other hand, he knows that every problem is in reality a new problem with characteristics that are different from those previously encountered. For this purpose facility with technique may not in itself suffice. What may be required is a new application of fundamentals, or a search for new generalizations from the past, to be applied in a new way.

Text-books on mechanics and kinematics therefore have two functions to fulfil. They require to present a detailed course primarily designed for improving the facility of the student in solving problems of an orthodox nature; or they may provide a reorganization of existing knowledge in new ways to throw up the underlying new principles to be found applicable to the future.

These two books, each in its own way and in its own field, deal with these separate issues. Profs. Timoshenko and Young, in this the second edition of their "Engineering Mechanics", have produced a first-rate text-book covering all the elements of statics and dynamics that fall within the scope of an orthodox set of courses—the principles of statics, concurrent and parallel forces in a plane, forces in space, virtual displacements, applications of Newton's Laws of Motion to particles and to rigid bodies, including some treatment of the gyroscope.

The illustrations throughout, although in the academic form usually associated with university courses, keep close to engineering practice. They are exhaustive, covering in each section almost every type of problem that arises, while a multitude of diagrams, clearly produced, serve to ease the development for the student. There are approximately 600 examples, many of them worked out in detail. Any student who has worked through this book will have received such a grounding in the application of orthodox dynamical principles that he will find no difficulty with the more specifically engineering problems that arise in other parts of his course. The book is excellently produced.

The other line of approach to which we have referred is stressed in Prof. Sloane's treatment of engineering kinematics. While the general headings are simple and straightforward—the rigid body, vectors, motion, displacement, velocity and acceleration—throughout the work there runs an underlying philosophical current to the book, and the fundamental concepts are critically examined and developed in a way that must be attractive and interesting to the student. Naturally a great deal of its scope is covered or implied by the previous book by Timoshenko and Young, but there is a great advantage to the budding engineer in his understanding of the principles of mechanism in being forced to study the classifications into which the multitude of mechanical devices can be subsumed. Definitions that seek to distinguish between mechanisms, machines, and instruments, for example, and so enable the wide variety of gears, cams, and linkages to be classified for their similarities and their differences, enable the author to bring out law and order throughout the whole of his text where otherwise diversity only tends to be seen. The simple headings of his chapters, already referred to, side by side with the many diverse types of illustration that fall within these heads, serve to underline this point.

It will be seen, therefore, that the particular virtue of this book lies not so much in the choice of material from the field usually covered in courses on mechanism, but rather in the pedagogical method of approach which fosters an appreciation of the common kinematical background. Like the previous book, the publishers are to be congratulated on their excellent production in paper, printing and diagrams.

Motor Vehicles and their Engines

Fifth edition, by Norman G. Shidle and Thomas A. Bissell, with the assistance of Tench Francis. Pp. vii+339. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1941.) 16*s*. net.

FOR the student who is interested in learning to do practical repair work on motor-vehicles, the first consideration is that he should obtain a comprehensive knowledge of the construction of the vehicle and its engine and equipment, and also of the principles which have governed its design. Formulæ and calculations are of secondary importance, as the repairer's work is the readjustment or renewal of parts which have gone out of order in service.

This book is designed for the student entering upon the subject for the first time, and is equally valuable for the owner-driver who wishes to take a close practical interest in his car or the transport manager whose duty it is to be familiar with the details of the fleet of vehicles under his supervision. Although it deals with current American practice, it is none the less useful in Great Britain on that account, as the main features of design are well standardized. The descriptions and explanations are given in terms which will present no difficulty to any class of reader; technicalities have been reduced to a minimum and fundamentals are stressed in the simplest possible manner.

In each section of the work, a sufficient outline of the fundamental theory is given, and special mention may be made of the way in which the electrical equipment is introduced by a statement of the theory of magnetism and electricity. Then follows the descriptive and explanatory text relating to the parts under discussion, and this generally terminates with a description of the mechanical troubles most likely to occur. In this way the student is led directly from theory and construction to the actual contacts, whether formal or informal, which he will make with the problems of maintenance and repair, and prepare him for the best use of the instruction handbook issued with each vehicle. J. A. C.

Bibliographia Primatologica

A Classified Bibliography of Primates other than Man. Part 1: Anatomy, Embryology and Quantitative Morphology; Physiology, Pharmacology and Psychobiology; Primate Phylogeny and Miscellanea. By Theodore C. Ruch. (Historical Library, Yale Medical Library, Publication No. 4.) Pp. xxvii+241. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1941.) 8.50 dollars.

THE scope of Dr. Ruch's bibliography is fully indicated by its title. It makes available, both to laboratory workers and to others who are interested in the subject, a comprehensive list of published papers on the anatomy, physiology, pharmacology and psychobiology of monkeys and apes.

The anatomical section deals first with embryology and general morphology, and then with the various systems of the body. The physiological and pharmacological papers are also classified primarily according to the body systems, while the section on psychobiology is organized by broad subject headings. The further subdivision of the various sections is excellent, and it is a simple matter to find whether or not papers have been published on any aspect of the primates. There is considerable cross reference, and there is an index of authors which includes some two thousand names. A very large number of individual papers are cited. The abbreviation of journal titles is according to the World List of Scientific Periodicals.

Dr. Ruch deserves the warmest thanks of students of the primates for having successfully undertaken a most laborious and painstaking task. "Bibliographia Primatologica" represents both a great public-spirited achievement and a monument to what is already known about man's closest relatives in the animal world. His work will lighten the effort not only of research workers already engaged in this field of study, but also of recruits to the subject.

Thermionic Valve Circuits

By Dr. Emrys Williams. Pp. viii+174. (London: Sir Isaac Pitman and Sons, Ltd., 1942.) 12*s*. 6*d*. net.

BASED upon the lecturing experience of the author, this book presents an outline of the theory of the operation and design of thermionic valve circuits in a form suitable for university students during the final year of their degree course in electrical engineering. The treatment is confined to a consideration of the principles of the use of valves in their various forms in radio transmitters and receivers, and no attempt is made to describe how the different functions are realized in practice. While it is assumed that the reader has a knowledge of alternating current theory and the associated mathematics, a short summary of the vector algebra required for this subject is given in the first chapter. Subsequent chapters deal with the valve, and its use as an amplifier, oscillator, detector, frequency changer and modulator. The treatment throughout the book is very clear and straightforward, and appears to be almost entirely free from errors or misprints.

While there are one or two places in which the descriptive matter might have been expanded, the author has probably been wise in keeping brevity before him as one of his main objectives. Certainly the modern, hard-pressed university student will appreciate this in a book which is admirably suited to his purpose.

The Cathode Ray Tube and its Applications

By G. Parr. Second edition. (First published under the title "The Low Voltage Cathode Ray Tube".) Pp. viii+180. (London: Chapman and Hall, Ltd., 1941.) 13*s*. 6*d*. net.

THIS book was first published in 1937 under the title "The Low Voltage Cathode Ray Tube", which was somewhat misleading in view of the fact that it deals with the various forms of cathode ray tube operating at accelerating potentials up to about 5,000 volts. The first three chapters deal with construction and operation of cathode ray tubes, their focusing arrangements and the interpretation of the patterns traced on the screen for various currents or voltages applied to the deflecting system. After two chapters devoted to time base circuit arrangements, the remaining chapters deal with the application of the tubes to various radio engineering, including television, and industrial uses. The book concludes with an appendix on photography and a most valuable classified bibliography of the subject.

The publishers are to be congratulated on the general production of this book, especially on making it much slimmer by the simple expedient of halving the thickness of the paper. The book should prove most useful to all those—and they are very many indeed just now—whose duties bring them very frequently into contact with cathode ray tubes.

PHYSICISTS AFTER THE WAR*

By SIR LAWRENCE BRAGG, O.B.E., F.R.S.
Cavendish Laboratory, Cambridge

WHILE scientific men of all kinds have been called upon to use their skill and knowledge for the nation's service in the present War, certain classes have been in especial demand, and the physicist is ranked among these 'scarcity categories'. The demand for physicists exceeds the supply, and universities have been pressed to train as many men as possible to fill the gap. There was no such general demand for the services of scientists in the War of 1914–18. Although there were some technical applications which called for trained scientific men, in the main that war was fought with comparatively simple gear. Physicists are now being used to develop and use all the lighter apparatus of war, the instruments for communication, for detection of aircraft and submarines, and for direction of our batteries. They are increasingly applying their analytical technique to operational research into the most effective way of using our weapons. Many of these latest developments are directed by men supplied by our industrial or university laboratories.

Physicists in general have been drawn into the service of the country in a way that has never happened before, and for the university scientist in particular this has meant a change of outlook and of occupation of a very revolutionary kind. In peacetime, the pure scientist, as contrasted with the applied scientist, works in a world of his own, not because he is an unpractical dreamer, as is often supposed, but for a very different reason. He is generally carrying out his particular task, the discovery of new knowledge, in an efficient and practical way, but although his researches may eventually have far-reaching consequences in altering the conditions of everyday life, he is cut off from these applications by a long interval of time. It is unusual for any great discovery in pure science to find an application in everyday use in less than thirty or forty years, since this time is required for the technical industrialist to see its possibilities and explore methods of using it for practical purposes. In the War, the pure scientist has to join the applied scientists and become a technician. He has to use his skill and knowledge to aid in devising gear which can be put to practical use in one or two years. A wider world has been opened up to men of science as the result of their being drawn into the War. They see more of the way the country is run. They are accused, with considerable justice, of being somewhat free in their criticism of many of the things they are seeing for the first time. Some of these criticisms are ill-founded, being due to a slowness in realizing that a country is a more complex entity to organize than a laboratory, but some are worth listening to, because they come from a body of men whose discoveries have been largely responsible for introducing the new technological era, which has completely altered the way we all live.

One thing has been clear. It has been of immense advantage to Great Britain in this struggle to have a reservoir of scientific researchers on which to draw. Their contributions cannot be described now, but when it is possible to do so, it will be found that our men of science have played no small part at more than one critical time. We are all hoping that we shall not drift back after the War, but will use our national assets of character and brains to make the country a better one than it has been during the last twenty years. I wish here to take stock of one particular part of these assets, our body of physicists, attempting to see what material we have got and make some suggestions as to how we could train and use it better.

My own experience has been gained in university work, and it is inevitable that this article should reflect the views thus engendered. I should be very sorry, however, if any part of it were taken to indicate a belief that the physicist who devotes himself to pure science has higher ideals or is more representative of his profession than his colleague who devotes his gifts to applied science. It is to our discredit as university men that we should sometimes be accused as a body of holding such views; it is evidence of a failure to take responsibility and enter into the life of the country. I hope, on the other hand, that it will be clear from what I have written that I am seeking to set our own house in order, to see how we can best equip the students committed to our care to take their part in applying their science for the benefit of all.

A Census of Physicists

It is interesting to assess the number of scientists, and of physicists in particular, in Great Britain. An estimate can be got in two different ways which roughly check each other. In the first place, we can find from the records of universities the rate at which scientists are being produced. The calculation is most straightforward in the case of the large modern universities. Each of these, such as Birmingham, Manchester, Leeds, or Liverpool, is the centre of a drainage area separated by watersheds. The students on the whole join that university to which they can travel backwards and forwards daily from their homes, and so one can calculate with some exactitude how many millions of the population each serves. From my experience at Manchester and as external examiner in other universities, I arrived at a rough estimate that one good physicist was bred per year per million inhabitants. By a good physicist I mean a man capable of independent thought, with a flair for his subject. For example, at Manchester, where we had excellent secondary schools seeking out and training all likely material, three or four such men a year was the average product drawn from a population of about four millions.

Again, we now have for the first time a census of the men of science in Great Britain; it is provided by the Central Register initiated by the Royal Society. The card index of the Central Register contains the names of all scientists in Great Britain, together with information about their scientific careers, experience and special interests. The term 'scientist' is not easy to define, but it has been taken to cover all who have received higher scientific education, have taken up a post in industry, Government service or the universities, and have continued to use their scientific knowledge for research or administration. The total number of scientists on the list at the beginning of the War was 12,000, of whom 1,200 were physicists. We may compare this with the above estimate that the population of Great Britain of 45 millions is producing one physicist per million per year; if one takes an average working life of thirty years, the two estimates agree. It is of course true that the relative numbers of scientists in different categories might be changed by a change in the

* From a lecture at the Royal Institution, delivered on March 26.

importance and interest of the various branches, but it is doubtful if the grand total could be much increased. The net cast by the system of scholarships is so effective that most school students who show intellectual promise have the opportunity of higher education. One curious exception is to be noted, the very small proportion of scientists coming from the great public schools. Whether this is due to the direction of the brightest boys at these schools into other subjects, or to the fact that boys from the well-to-do homes which can afford a public school education are naturally drawn into other walks of life, I do not venture to judge; but it is an interesting fact, for example, that among the heads of physical laboratories in Great Britain, only one in a hundred received his education as a boarder at a public school. The secondary schools and grammar schools are the source from which the body of British scientists is almost entirely drawn.

Fundamental Research

How can we best use the physicists which Great Britain breeds, both for pure research and for the equally vitally important industrial research? To take in the first place the well-head from which the flow of scientific thought starts, the fundamental research divorced from all thought of its ultimate use or effect, we may claim that this is one of our great assets. Complacency is always disastrous, and I do not want to be understood as asserting that there are no improvements to be made in the system of combining such fundamental research with university teaching which has grown up in Great Britain. But with all its blemishes, this system has succeeded in keeping our science, and physics in particular, well in the forefront of the world's scientific endeavour, and this success is due to the existing structure.

I think this is worth stressing because ardent reform is in the air, particularly in the direction of a more conscious planning of the fields of research and their division between different centres, and of the foundation of institutions for pure research divorced from teaching. Proposals for the latter should, I think, be scrutinized very carefully. The great asset of university research is the constant flow of young men through the university, bringing their own original and fresh minds to bear on the lines of work of the school to which they come, and of the contacts between men engaged in widely different subjects. Some few men of science remain individualists all through their careers, working alone or with one or two assistants. Examples of physicists of this type must be in all our minds, and we recognize the great contributions they have made to our science. But the majority, after the first decade of their research careers, continue to live their scientific lives for the most part through their students. Battening upon students, using their freshness for selfish ends, is of course one of the major scientific crimes, and unhappy is the laboratory which has such a head, but there is a better and more normal side to the picture. The purest pleasure in scientific work is to see the germ of an idea one has planted in a younger man's mind develop in a way and to an extent one could not have achieved or foreseen oneself, and to see him get recognition for his work. I think too that teaching, if treated as the art of putting ideas in a simple and fascinating way, is one of the great safeguards against getting stale. There are many periods when research goes badly and is disappointing, and it is refreshing to have as a background the regular teaching routine, with the satisfaction it brings of a necessary and congenial task duly accomplished.

In contrast to the flow of keen young research students through a university, a central research institution has a comparatively static staff and there is considerable danger of fossilization. As would be expected, this tendency is much more noticeable in the later stages; it is scarcely likely to appear within the first decade of an institution's existence. It is less likely to occur when the central institution has a constant flow of men through it, who are given research grants and are attracted by the special facilities for work in their chosen line, for such a place is in effect a school for postgraduate study and has the same advantages as a university. Fossilization is seen at its worst in the laboratories where there is no such flow, where members of the research staff enter as young men and continue to do work of much the same character throughout their lives, and where advancement is rather by seniority than merit.

To sum up, it is doubtful, to say the least of it, whether the advancement of pure science is fostered by taking men from universities and setting them to work in central research institutions devoted to some special branch, however fine its buildings and equipment. The necessary stimulus appears somehow to be lost. A curious fatality attends such conscious planning of research. Large endowments given to special fields are apt to produce comparatively meagre results, which are completely outdistanced by some unplanned fundamental discovery appearing at first to have little bearing on the subject. Polanyi (Manchester School of Economic and Social Studies, Oct., 1938) has put this point very well in an article on the "Rights and Duties of Science". It will be objected that a central research institution can provide equipment and other facilities on a scale which may be impossible at a university, and I think that this valid objection points the way to the right solution. The strikingly successful places of this kind are those which may be regarded not as a body of men, but as a body of equipment. Such a place has a nucleus of permanent staff and accumulates traditions of technique peculiarly its own, but its main service is as a place open to all for short periods of intense work, and its main population a changing one.

Physics in Industry

Although we have good reason to be proud of the contributions made by Great Britain to fundamental scientific knowledge, we cannot feel satisfied that full advantage is taken of this asset in our industries. The educational system has a heavy responsibility to bear. In Bernard Shaw's "Major Barbara" the millionaire Undershaft is looking for a successor to whom he can hand over the control of his great armament firm, and deplores the difficulty of finding a boy of native genius who has not been spoilt: "if he shows the least ability, he is fastened on by schoolmasters; trained to win scholarships like a racehorse; crammed with second-hand ideas; dulled and disciplined in docility and what they call good taste; and lamed for life so that he is fit for nothing but teaching."

The bitter truth of this reproach must have struck many who have trained successive generations of honours students at a university. In former days many boys of the right type went straight into industry, and Great Britain's leading position was

largely due to their inventive genius. Nowadays the majority get scholarships which enable them to go on to universities, and it is our responsibility to see that we give them the right training and send them back to industry to play their part. Two difficulties stand in the way. In the first place, the boy has lost something vital through the too close attention to his studies demanded by the need to win scholarships and pay his way. We cannot sell him to the industrialist when we have finished with him; he has not learnt to mix with other people and form one of a team, to take responsibility, to trust his own judgment and have initiative. Such qualities are learnt through games, hobbies, camps, running school activities and a host of other things which most boys get but from which the really clever boy is too often largely debarred by being recognized as a potential scholarship winner. In the second place, too many of our best students want safe jobs with immediate returns. The sacrifices they and their parents have made, and the work they have put into their learning, make them feel that their high honours degree should by itself be a qualification for a good post. They regard their training as a guarantee that they shall be put in a senior position, not as a preparation which should help them to show that they deserve one. When they go into industry and come in contact with men who have not had a university training, there is irritation on both sides. The industrialist compares them unfavourably with boys who have worked their way up and become men of the world; the university product cannot understand why the knowledge he has so painfully acquired does not entitle him to immediate recognition.

I have purposely painted the picture in the darkest colours, knowing well how many cases of success might be quoted in refutation, because I wish to consider the remedies. I think the long course through grammar or secondary school and university represents too unbroken a concentration on the acquisition of knowledge. I have on three occasions had the interesting experience of being a visiting professor for several months at various American universities. Although science students in Great Britain may be more advanced on the purely academic side than American youths of corresponding age (they can answer harder examination questions), it was my impression that the American student is more practical, handy, and bold at setting up apparatus. He gets this largely through his experience in the long summer vacation, it being a general practice to engage in some form of manual work. It is not so easy to organize similar activities for our students, though a certain number already are taken on for short periods by industrial firms. I think, even when this is done, that the periods are too short and come too late. The important time to make the break, it seems to me, is between school and university. If all our honours physics students had at least six months working for an apprentice's wage in some industrial concern, before they came to the university, I believe it would be of the greatest benefit not only to those who plan an industrial career later, but also to those who will become teachers of the next generation in due course and should have seen something of a wider world.

One suggested scheme for the future is therefore to copy our engineering confrères, and encourage physics students to put in a spell at works between school and university. Another suggestion is to follow the example of the medical schools. Though a large part of the teaching in a medical school is done by the permanent staff, an important part is that given by practising physicians and surgeons in the form of short specialized courses. Why not invite some of our leading technologists to do the same in our physics schools? As well as giving the students a valuable experience, it would give the industrial experts a place in our universities, a right to take part in their counsels and help to guide their policy.

Finally, there is the possibility of bringing back senior men in industry for short or long university courses specially arranged for them. Such courses can range from a conference devoted to intensive study of some special branch lasting for a few days or a week to a refresher scientific course extending over months. There is one conclusion to which I have come, as a result of being concerned in the organization of short courses of this kind, which applies to all types. The most successful examples are those where the university has concentrated on giving the industrialists a well-prepared summary of recent advances in pure or fundamental science, not those where it has attempted to go outside its own field and talk about "Physics in Industry". Let each man stick to his own job. Advances are so rapid, the literature is so voluminous, that a busy industrialist must find it difficult to keep abreast of the times. This is where his university colleagues ought to be able to help him, if they are worth their salt. They can sort the wheat from the chaff, tell him what new ideas are important and what are not, and provide him with a background of knowledge which he can use to solve the many problems of his particular industry. The industrial physicist on his side has something to which the university physicist cannot aspire, a wide and expert knowledge of the many problems of his industry and a sense of values as to what is important to it. It is for him to see how this new knowledge may aid him.

The same consideration applies in another way to research carried out in the universities at the behest of industry, and perhaps supported by it. Such arrangements forge the links closer, which we all desire, and can have highly important results. They must fit in, however, with the main function of university research, which is to increase the body of fundamental knowledge irrespective of its immediate application. This separation of function must be kept in mind. Any knowledge discovered at a university should be free to all, and the university scientist should not be forced to keep his knowledge in water-tight compartments, to remember what he may divulge and what he must regard as the peculiar property of a particular outside body which is financing a research in his laboratory. Freedom of discussion and exposure of his work to general criticism are the breath of life to the university worker.

Physicists in the Service of the State

The industrial research associations and laboratories partially or wholly supported by the nation, which have been started since the War of 1914–18, are in some respects in an intermediate position between the universities and industry. Their work is designed to help their particular industry, but they are also repositories of general knowledge and are in a position to undertake long-range research which will ultimately benefit the whole industry, as well as to apply themselves to particular problems of immediate interest.

With no disparagement of the achievements of these associations, and with full recognition that they

represent a new experiment in organization of scientific endeavour, in planning for the future one cannot consider that the last word in defining their scope and function has been said. They have peculiar difficulties of their own. The university research worker is kept on the alert by the excitement of the chase. He is free to pursue any fascinating line which opens up, irrespective of its applications. He is hardened by the unsparing criticism of other experts if he makes mistakes of fact or logic, since his work is published and runs the gauntlet of free discussion. The industrial physicist is kept on the alert by the demands of his industry. What he is doing may affect the success or failure of a costly process, or lead to a new product for which a wide demand is anticipated. He runs the gauntlet of criticism by his colleagues in the works, and of the fierce test of results. The danger of the research association is that of its men working in a vacuum, where they miss both of these incentives.

I am emphasizing the difficulties of the research associations, not minimizing their achievements or suggesting that the experiment ought to be discontinued, a proposition to which I should be the fiercest of opponents. One ought, however, to face the existence of a widespread opinion that the flow from the research associations of Great Britain of fundamental ideas which would profoundly affect our industries has not yet reached the volume which had been hoped for and anticipated. Lip service is paid to research because it is respectable and fashionable to do so, but responsible industrialists in private express their disappointment. This is a challenge which must be met.

It seems to me that the difficulty partly arises from a wrong conception of the nature of research. To set aside a definite body of men, in a central institution, with orders to spend their whole time on research with some definite end in view, is to court disappointment. I come back to the idea of a central research association as being ideally a permanent laboratory with specialized equipment but with a changing population, not as being a permanent body of men.

While at Manchester I had an arrangement with certain firms which worked successfully. If one of their staff had a good idea, and the firm wished him to develop it without being subjected to the distractions of the works and its contacts, he was given a quiet laboratory at the University as temporary quarters. Should not the industrial research association be a place to which firms send suitable men from time to time, where equipment and assistants are available, and where they can for a year or more develop some good idea of the longer-range type? This plan has already been followed; I claim no originality for any of the ideas put forward here, but merely record those which I believe to be along the right lines. The opposite side of the picture is one which is only too commonly seen. A committee sits to direct a certain branch of research and a member proposes an investigation as worthy of attention. Staff and apparatus are set aside for it at the research association, and the men do their best to devise a technique and frame a programme. Through imperfect contact with industry, they drift off on work which may be excellent, but which is not really along lines of profound value. A committee is too impersonal a body to direct research, its members are generally too busy and important to give the necessary time and attention to detail.

When a new line of this kind is started in response to a demand by industry, it would be generally advantageous if at the same time an industrial sponsor were appointed, not necessarily a member of the committee, whose special responsibility it would be to visit the laboratory at short intervals and to spend quite a large part of his time in directing the effort. This is what in fact has happened in this War, and it is highly successful. Many extra-mural researches for the Services are being carried out in laboratories all over the country, and bodies like the Ministry of Supply appoint men from industry or from their own staff with precisely this function, who visit the research workers, who can be consulted freely, and who give just the required contact with what is actually needed. A day every other week of one expert's time is of infinitely more value than an hour or two of a large committee of well-known men which meets every two or three months. A similar plan widely carried out for industrial research would meet the need I have tried to express above; for the time being the sponsor drawn from industry would use the research association as his laboratory, to carry out his ideas, and there would be a constant flow of new people with new ideas through it.

Research and Administration

Some change in the methods by which Government scientific research is administered and financed appears to be very desirable. The Civil servant is, of course, right when he insists that everything should be done 'through the proper channels', and that attempts to short-circuit them lead to increased confusion and are essentially ineffective. There must be a recognized chain of authority by means of which action is taken. What we should ensure is that these channels are direct and open, not tortuous and clogged. It is here that sometimes one feels tempted to criticize the administration of research which is paid for by the Government, particularly research for the Fighting Services. An apparatus which is well designed for the administration and financial control of other classes of activity is inappropriate when it is applied to scientific research and development.

I believe the universities treat this problem in a better way. The ideal research unit is one of six to twelve scientific men and a few assistants, together with one or more first-class mechanics and a workshop in which the general run of apparatus can be constructed. I will add one further requisite: not only a good store of material but also of 'junk', old gear which has passed out of service but which provides a priceless source of oddments which can be used in constructing rapidly a first rough apparatus to try out some new idea. A famous man of science of a very practical turn of mind once told me that he regarded this junk as one of the most valuable assets of his laboratory; he was at the time feeling the pinch of moving into a tidy new building in which it had not yet had time to accumulate. Few who have an inspiration for a new piece of apparatus can visualize exactly how it will work to the extent of making a blue print of it. It grows by the close personal contact between researcher and mechanic, who should work side by side. It is not wasteful to duplicate lathes and other machines by giving each group its own workshop; the time of researchers is far more expensive than the overheads on machinery. With the same object in view, that

of allowing the researcher to try out his ideas with as little delay as possible, the decision as to what particular piece of apparatus should be bought is best left to the researcher in all but major items. He should have an allowance for apparatus, to be spent at his discretion. The bills are passed through a central office, but the important thing is that the researcher should be free to get what he wants while in red-hot pursuit of the idea, and not have to wait to convince a central authority that it is necessary and order through it. This makes for true economy in the long run.

It may be objected that the freedom from control advocated here would be abused if it were granted. The point to be made in answer is, I think, that the check upon expenditure should be one of general review at the end of regular periods, not one of each detail.

Appointments

The working of the Central Register has been so interesting that one would like to see a permanent body with the same function set up after the War. We train our students for three or more years at the university, devoting much time and energy to their preparation for their careers. Do we pay an adequate amount of attention to directing them into the right careers when they leave us, a matter which is in every way as important as their training?

Students are helped to find posts in two ways, either through the head of the department in which they have worked, or through a university appointments board. Outside bodies often apply to appropriate heads of departments when they have a post to fill, and consider they may have students of the right type, and much effective placing of square pegs in square holes is done in this way. However, I have always felt, as head of a department, that too much is left to chance by relying on applications of this kind.

A university appointments board has a better opportunity to survey the whole field both of posts and men, and many such boards do excellent work. They have their own particular difficulties, however. Too often the best men are placed by heads of departments or by their own efforts, without consultation with the appointments board, and the latter is saddled with the difficult task of finding posts for the less attractive candidates. This reacts unfairly on its reputation for supplying good men, and it also means that its wider knowledge of the field is of little use just where it should be most important, in the matching of the very best men with the best posts. An appointments board of the right kind should be the channel through which most appointments are normally arranged, not a last resort of the desperate.

I cannot help feeling that it would pay us handsomely to centralize the arranging of appointments of physicists after the War, much as it has been done during the War. Any central board which did this work for the whole of Great Britain would require an absolutely first-rate man at its head whom we could all trust, for he would have grave responsibilities, but the task is so important that it is a worthwhile one for such a man. I envisage the board as keeping a dossier of every physicist in the country, such as the Central Register now has in its records. The total crop of young physicists each year is two to three hundred, a comparatively small number to handle, and the total number in Great Britain is, say, ten times as great (any more precise estimate depends on the definition of a physicist). It should not be difficult to establish a central channel for advising men about suitable posts and helping the very best men to get the most important posts, as each year's contingent comes to be considered. I know that I, as head of a physics department, would feel much more confident that my students were taking up the right work if I had such a centre to consult. I would feel that it had a much wider knowledge of the possible careers than I could attain to by my own rather sporadic efforts, because all employing bodies would consult it when once its reputation was firmly established.

The implication of this suggestion will be realized. It is in effect a proposal to organize appointments boards by subjects rather than by universities, and would require careful planning before it could be made effective. The intimate personal knowledge of the student acquired by the department in which he has worked is fundamental to any scheme, but the War has taught us the value of having one centre for the whole country.

Summary

The foregoing appraisal of our assets and our problems may be summarized as follows. We breed the right kind of physicist, and the combination of pure research with teaching at our universities, together with the constant flow of young research students through university laboratories, is effective in producing fundamental advances in pure science of the highest quality. We are not so successful in using this asset in the field of applied physics, and some of the causes are analysed here and remedies suggested. The training of our physicists is literally too academic. This does not perhaps matter so much in the case of men taking up pure research, but it is a big handicap to the men going into industry. It is suggested that more of our physicists, now that their subject has made a recognized place for itself in industry, should have works experience as engineers do, and that the best time for the relatively shorter period they can afford to spend in works is between their school and university. An early experience of this kind would make it easier for the student to take his place in industry when he leaves the university.

We wish to ensure that the undoubted inventive genius and scientific ability of the students we train is used by industry to the best advantage. Striking successes have been achieved by industrial organizations which are large enough to have research laboratories of their own. The close contact with the works provides the inspiration and sense of practical values which are essential for fundamental and original ideas profoundly affecting the industry. Research associations represent an attempt to advance the standard of technical achievement for groups of firms, many of which cannot afford laboratories of their own. Although such associations have scored many successes, they have been successes of tactics rather than of strategy; the conditions under which they work make it difficult for them to produce the really fundamental ideas. It has often been stressed that a primary requisite for their success is that the firms which support them should be willing to pool their knowledge and consent to problems which they know to be really important being handed over to a central organization; no scheme can hope to work unless this is done. If such a pooling is carried out by general agreement, it

would be possible to alter the character of a central research organization. At present its greatest danger is that of becoming a static body of researchers cut off from the real needs of industry. It should be able to become a common research centre with a continuous flow of men through it, providing a laboratory where any man with a good idea could come to work it out, and a source of men going back into industry with a wider knowledge of all its problems. It is only under such conditions that really fundamental advances can be made.

THE EYE IN INDUSTRY

CURRENT interest in the health of industrial workers and in the maintenance of a high level of output made the conference on the "Eye in Industry", held under the auspices of the London Branch of the Institute of Physics on June 20, very opportune. During the first half of the proceedings six papers were given on different aspects of the subject, followed, after tea, by a lively discussion, in which many of the audience took part. The success of the meeting was enhanced by the kindly hospitality enjoyed at the South-West Essex Technical College, where the conference was held.

In the opening paper, Dr. W. D. Wright gave three reasons for a discussion on the eye in industry as opposed to the eye in other spheres of human activity. There is in the first place the special nature of many of the tasks that have to be undertaken and that are peculiar to industry, tasks, moreover, that have to be repeated and continued for many hours at a stretch. Secondly, there is the question of responsibility, either on the part of the employer or possibly of some Government department, for the health of the workers. In the home, the individual should, so far as his means permit, make his own arrangements for good lighting and avoidance of eyestrain, but in the factory the onus rests on the employer. Any discussion should therefore aim at stirring the interest and the conscience of the employer, providing him with the data that he may properly demand and informing him of the facilities already available for the adequate solution of visual problems. There is thirdly the question of output and efficiency, matters closely related to good seeing.

Hence, although the eye responds in the factory in much the same way as it responds elsewhere, yet there are excellent reasons for paying special attention to its performance under industrial conditions. The importance of the eye, as distinct from the other sense organs, lies, of course, in the fact that a very large fraction of our knowledge of the external world is derived visually. Nearly all the information which we have of our immediate surroundings and of the events taking place in the vicinity is obtained from the very variegated pattern of light, shade and colour which is focused by the lens system of the eye on to the light-sensitive retina. Shape, size, texture, distance and movement of an object are all observed and recorded because of the existence of contrasts between the object and its background and between different markings on its surface, as in the grain in a piece of wood, so that good seeing demands good contrast perception. Attention has to be paid to the image-forming part of the visual system, as this may be defective and require correction with spectacles, and also to the performance of the light-sensitive mosaic on the retina, which can detect small contrasts and resolve finer detail when the level of illumination is raised. Eyestrain occurs when the muscles controlling the convergence of the two eyes on to the object under examination and those governing the focusing of the lens system have to operate under conditions of poor visibility and distracting lighting. It is the job of the employer to provide conditions that achieve the best possible compromise between the requirements of his technical processes and the maintenance of maximum visual efficiency.

Mr. E. W. H. Selwyn illustrated this compromise by reference to the peculiar problems that arise in the photographic industry in connexion with the illumination of dark rooms. Sufficient light has to be provided to conduct the various photographic processes, but not so much as to fog the emulsion. In choosing the colour of the light to be used, a balance has to be struck between the parts of the spectrum to which the photographic emulsion is least sensitive and the eye most sensitive, taking into account the changing spectral sensitivity of the retina in dim illumination. It follows that the most efficient colour of the illumination will vary with the type of emulsion: orange for ordinary emulsions, red for the orthochromatic type, and green for the panchromatic and infra-red forms. In all cases the level of illumination is low, leading to poor visual acuity and contrast perception. As a consequence, objects such as dark room clocks must be large, and white markings should be provided to assist in getting about the dark room—aids reminiscent of the black-out.

Another interesting aspect of the problem is concerned with the time required to become adapted to the dark room illumination. In rooms illuminated by red light, vision, even when fully adapted, is mediated largely through the cone mechanism in the retina and the cones acquire their maximum sensitivity after only a few minutes. In the rooms illuminated by green light, on the other hand, the rods will operate, and as these take at least thirty minutes to acquire their maximum sensitivity, there is a marked difference in the adaptation times for the two forms of lighting. Mr. Selwyn also reported his experience that when working in a dark room he found that he required the aid of negative lenses with a power of -2 dioptres in order to focus distant objects clearly. This he attributed to the spherical aberration in the lens system of the eye, since at low intensities the iris is expanded and the marginal zones of the system come into action. There was some difference of opinion on this matter during the discussion, both as to magnitude of the effect and its cause. It would appear that some observers have not been conscious of the need for negative lenses; indeed, one speaker maintained that positive lenses were required, yet it is not a matter that should be lightly dismissed without further investigation.

The part played by light in aiding the performance of the eye was dealt with by Mr. W. R. Stevens. He stated the basic principles of good lighting, including adequate illumination, reasonable uniformity, freedom from glare and the provision of the proper contrast between the object and its surround. He urged the greater use of colour, both as a means of improving contrasts and in brightening our workshops; in Great Britain we tend to be conservative in our devotion to greys and other dull colours for the decoration of machinery, with the notable exception

of the gaily coloured agricultural machines. An important advance in the last few years has been the introduction of the fluorescent tube as a light source; its extended area and low brightness result in a reduction of hard shadows and the absence of glare, while through the choice of the fluorescent material, the colour can be controlled very successfully. A good approximation to daylight can be obtained, and, through the employment of daylight fluorescent lamps, the illuminating engineer can mix artificial light with daylight without introducing the disturbing aesthetic appearance noticeable when ordinary tungsten lamps are used in a room which is simultaneously being illuminated by daylight.

Questions were asked about the extent to which the design of lighting installations should attempt to simulate daylight, both in its colour and distribution; the evidence goes to show that generally we prefer the lighting to which we have been accustomed, so that any tendency towards one particular form of installation has no justification from experience. The design of windows and daylighting is largely an architectural problem, and for illuminating engineers to arrange their lighting fixtures to give an imitation of window lighting would impose an unnecessary, artificial restriction on the freedom they otherwise possess.

Mr. G. H. Giles, who spoke from the point of view of the optician, claimed that the optician is in a position to act as a clearing station for the specialist —the physicist, the illuminating engineer, the medical practitioner. There is a very obvious need for close attention to refractive errors among the workers in industry, since statistics, many from the United States, show that the percentage of workers with visual defects is very high. Correction of the defects with spectacles leads to roughly 20 or 30 per cent increased production, with a corresponding decrease in the discomfort and fatigue of the worker. Naturally, there is a greater tolerance for defects in one type of work than in another, but there are occupations where visual aids are desirable, even though the vision of the worker is normal. Thus, where prolonged close work is involved, it has been found that much of the strain can be removed if the worker wears a pair of glasses which combine a lens and prism for each eye. In this way most of the need for excessive focusing and excessive convergence of the two eyes can be avoided, with a consequent lessening of the muscular effort; Weston and Adams have shown that great benefits have resulted from the use of such aids, leading to a marked reduction in fatigue and eyestrain, and a significant increase in output. During the discussion, the value of spectacles of this type was especially emphasized in the case of prolonged near work and it was considered that they could be employed on a far wider scale than is the case at present.

Tests for eye defects other than refractive errors, such as colour blindness and defective night vision, may also be needed. Recently, a number of workers at a factory claimed to have poor night vision, but when tests proved them to be normal, it transpired that they had hoped in this way to avoid fire-watching duties! Opticians also deal with protective glasses against damage from different radiations and from other hazards such as flying chips and molten substances. Finally, Mr. Giles referred to a scheme inaugurated by the Joint Council of Qualified Opticians for testing the vision of factory workers, whereby a rota of opticians is made available for the purpose. A valuable service was being performed in this way before the War, but during the War the scheme has proved even more useful and has been officially adopted for Royal Ordnance Factories.

The routine eye examination carried out by opticians under the scheme of the Joint Council of Qualified Opticians was described in some detail by Mr. R. A. Rider. As the testing of each patient may occupy at least thirty minutes, the time required to deal with a works in which, say, 20,000 persons are employed is very great. The tests may therefore have to be directed in the first place to those who show symptoms of ocular defect.

In the final paper Dr. H. Lowery broached a rather different aspect of the subject when he referred to the part played by the eye during training for such activities as carpentry, metal work and other technical handicrafts. This is very much a question of securing proper co-ordination between hand and eye and it is important, especially at the present time, to know why and how training improves the visual processes. Before the War of 1914–18 it was customary in schools to give special classes for what was called "eye training", but since then the method has been discarded. It is undoubtedly in part a psychological problem, as are, in fact, all visual problems, and training undoubtedly induces alertness in making particular types of observation. In the discussion, for example, reference was made to the very high accuracy to which a trained workman could judge angles and other dimensions of an object. Another point was made that, in problems of discrimination and visual estimation, the boundary line between physiology and psychology is rather vague, so that the possibility that training may modify the response of the eye as well as the reaction in the brain ought not to be overlooked.

There is obviously a great deal still to be learnt about how the eye works and how to apply the information that is available. The problem is a vast and intricate one and the conference served to bring different interests together to form a pool of knowledge, knowledge that has somehow to be passed on to the whole industrial community.

CANCER RESEARCH IN GREAT BRITAIN

THE eighteenth annual report of the Grand Council of the British Empire Cancer Campaign (11 Grosvenor Crescent, London) was issued in February. At the meeting at which the report was presented, it was stated that more cancer research had been carried on during the War than had been anticipated in 1939. The summary refers with justifiable pride to "the lead in cancer research which Britain is still giving to the whole world". On account of this, appeals for financial assistance for the Campaign which had been discontinued at the beginning of the War will be made again.

The report itself has its familiar form, and shows that a considerable amount of work has been carried out in Great Britain, though there is little research to report from the Dominions. During the year which ended last summer the campaign expended almost £45,000 in supporting research workers and institutions.

Advances in our knowledge of cancer have been made in many countries. Important contributions

have been made in the United States to our understanding of the nature of filterable tumours and the inheritance of cancer in mice. Japanese workers have made important discoveries on the experimental induction of liver tumours. But "the study of cancer-producing and cancer-inhibiting substances is predominantly a British study". Perhaps the most interesting carcinogenic agents are those which occur in living organs. The first descriptions of such substances came from Russian workers. Examination of bile and liver tissues has been carried on in Great Britain, and tumours have been produced in mice by injection of extracts of human livers.

The testing of more than seventy compounds related to known carcinogenic compounds during the last three years at the Royal Cancer Hospital has shown that the capacity to produce skin tumours by painting does not always run parallel with the capacity to produce sarcomata by subcutaneous injection.

Progress has been made in the study of the metabolism and excretion of carcinogenic hydrocarbons. The fluorescence of these compounds makes it easy to follow their excretion. At the Royal Cancer Hospital it was shown that when 1 : 2 : 5 : 6 dibenzanthracene is fed to rabbits it is excreted in the urine as a dihydroxy derivative, and later American work has confirmed and extended this finding. Prof. F. Weigert and Dr. J. C. Mottram have shown that the fluorescence of benzpyrene varies from blue to violet in animals injected or painted with the compound. The blue fluorescence is seen in the bile of treated animals. At the Glasgow Royal Cancer Hospital, work on the metabolism of benzpyrene indicates that a hydroxy benzpyrene is excreted in the bile of animals injected with the hydrocarbon.

Workers at Leeds have produced tumours of the bladder in dogs after very prolonged dosage of pure β-naphthylamine by mouth. This confirms the earlier work of Hueper in the United States, and indicates that β-naphthylamine itself is probably the primary cause of cancer of the bladder in dye workers. Careful research carried out in Newcastle-on-Tyne has shown that wood smoke such as is used for smoking food is not carcinogenic to animals.

Most carcinogenic compounds inhibit the growth of normal and malignant tissues, and the correlation between carcinogenicity and growth-inhibiting power has been thoroughly investigated at the Royal Cancer Hospital. Two compounds—1 : 2′ azonaphthalene and 1 : 2′ diamino 2 : 1′ dinaphthyl—have been found to be inhibitory but noncarcinogenic. It is suggested that some compounds of this type might be tested clinically for treatment of cancer.

Animal tumours can be grown in tissue culture and often, on retransplanting into animals, lead to development of tumours. A mouse tumour grown *in vitro* in this way in Birmingham for more than eight months was able to produce tumours in mice and then lost this power of growing *in vivo*. In Glasgow a fowl tumour grown in tissue culture did not always produce tumours when inoculated into fowls. There is evidence that tumours while still growing in tissue culture may lose their ability to grow in animals.

Photomicrography of irradiated malignant tissues, using monochromatic ultra-violet light, shows the position and amount of nucleic acid material in cells. In eleven out of fifteen cases examined, a striking increase in nucleic acid in the cells occurred after irradiation. The increase in nucleotide material is not confined to malignant cells, but has also been observed in normal and hyperplastic tissues.

In spite of difficulties due to the War, progress in technique of therapy by radiological methods continues. At the Mount Vernon Hospital it has been shown that treatment of carcinoma of the vulva with a given dose (1,200 r.) is much more effective if given at high intensity (350 r. per minute) than if given at low intensity (20 r. per minute).

At St. Bartholomew's Hospital more experience has been gained in the clinical application of the million volt X-ray apparatus. An increasing number of patients is being treated and the results obtained suggest that it is particularly effective in treatment of cancer of the rectum, a site in which treatment by softer X-rays has not hitherto yielded satisfactory results.

Mr. E. N. Willmer in Cambridge has examined the effect of trypsin on cultures of chick heart fibroblasts. A 1 per cent solution of the enzyme had only slight toxic effects but caused the cells to round off. A more dilute (0·1 per cent) solution caused the constituent cells of embryo chick heart tissue to fall apart. The separated cells were able to grow and form new colonies of cells.

Dr. A. W. Greenwood has continued to supply chicks and fowls to research workers investigating the pathology of fowl tumours. Careful observation and breeding of Brown Leghorn chickens has shown that there is considerable variation in susceptibility of this stock to the Rous No. 1 sarcoma. The inheritance of variation in susceptibility is being studied. The susceptibility in any one bird is not necessarily extended to all tumours. Thus a transplantable chemically induced tumour grows in birds from a strain resistant to the Rous No. 1 tumour agent.

Variation in reaction to the Rous tumour virus has also been encountered at the Middlesex Hospital, where the birds of a Light Sussex - Plymouth Rock cross could not be immunized, while Brown Leghorn fowls readily develop immunity to concentrates of Rous sarcoma. The low resistance of the Light Sussex cross-bred fowls may be connected with the capacity to yield chemically induced filterable tumours which have occurred in these fowls at the Middlesex Hospital laboratories. The serum of susceptible fowls may be able to agglutinate the Rous virus without neutralizing it, while the serum of resistant fowls may contain neutralizing antibodies without agglutinins.

Many efforts have been made to demonstrate a virus in 'non-filterable' tumours. At the Glasgow Royal Cancer Hospital filterable and non-filterable tumours have been compared by inoculation of tumour material which has been ground with and without sand. Filterable tumours are still transmissible after grinding with sand, but the infectivity of other tumours is destroyed by such treatment. Filterable tumours transmitted with ground tissue "grow in a diffuse manner with ill-defined edges, so that the muscle substance is deeply infiltrated over a wide zone". The non-filterable tumours grow from multiple foci, suggesting that they have developed from isolated cells or cell clumps; such tumours depend for their transmission on the inoculation of a sufficient number of viable cells. Work in the field laboratory at Sheffield indicates that the simultaneous injection of mouse tumour tissue treated with glycerol does not influence the incidence of tumours induced in mice by the injection of methyl cholanthrene.

The Clinical Cancer Research Committee of the Campaign presents a report in which material collected in 1938 and 1939, particularly with regard to uterine cancer, is considered in detail.

The body of work which is reported indicates that the impetus of cancer research in Great Britain even in war-time is considerable, and that with a return to peace-time conditions extremely rapid progress should be made. E. BOYLAND.

ECONOMIC VALUE OF THE COMMON STINGING NETTLE

By DR. C. R. METCALFE
Royal Botanic Gardens, Kew

IT is a well-known fact that the common nettle (*Urtica dioica*) yields a very strong bast fibre which was used in Great Britain until about 1860 for the manufacture of cloth. Since then its use has been discontinued because other cheaper, imported materials became available. In the past, nettles have been cultivated also in France and other parts of Europe for the production of fibre.

During the War of 1914–18, the Germans were quick to recognize the value of the nettle as a source of fibre. According to published information, 10,000 tons of wild nettles were estimated to be available in Germany. The collection of these was undertaken largely by children; transport being arranged in collaboration with the military authorities. The whole organization was controlled by the "Nesselfaserverwertungs-Gesellschaft" and the "Nesselanbau-Gesellschaft" which operated from Berlin, while the "Bayerische Nesselfaser-Gesellschaft" had offices at Munich. The estimated yield was between 1,500 and 2,000 tons of fibre, valued at between two and three million marks. This was to be used chiefly in the manufacture of textiles. At the same time, 3,000 tons of food from the leaves and 3,000 tons of by-product material suitable for use in paper and chemical factories were to be extracted. Other extracts included lignin, chlorophyll and potassium nitrate, while nettle products were even used in the manufacture of gas mantles[1].

At the outbreak of the present War, the German Government immediately appealed to the general public to collect nettles once again[2]. Apparently the nettles are still being used with success, for it was reported from Stockholm in the *Daily Express* on June 8, 1942, that about 5,000 railway carriage loads of stinging nettles will be collected in Hungary this summer for use as raw material for textiles.

Although most of these facts have been known in Great Britain for many years, it is only recently that it has been possible to arouse any interest in nettle fibre in commercial circles. The availability of more familiar fibres, and other causes, have closed our eyes to the possibility of making use of a very common and troublesome weed. About two years ago, however, samples of nettle bast fibre were extracted at the Royal Botanic Gardens, Kew, and sent to another institution for certain experiments which were then in progress. Tests, which were then made, fully confirmed that the bast fibre is remarkably strong and that it consists of a very pure form of cellulose. Other tests on fibre extracted at Kew were also made at the Imperial Institute, where it was demonstrated that good-quality paper can be made from the bast fibre. Larger samples of nettle fibre were prepared in 1941, which were examined by paper-making firms in Scotland, and pronounced to be very satisfactory. From the *World's Paper Trade Review* of May 15, 1942, it is learned that a Renfrewshire firm of paper-makers is prepared to purchase 1,000 tons of nettles this summer at a minimum price of £10 per ton, and that another firm in Fife is willing to buy 200 tons for experimental purposes. In the same journal it is also stated that steps have been taken to cultivate several acres of nettles for the same purpose, care being taken to do this only on land which is unsuitable for other crops.

It must be emphasized that the samples extracted at Kew consisted only of the bast fibre; the wood fibre, which possesses quite different properties, was a waste product. Unfortunately, it is difficult to reduce the wood fibre to pulp, so that this material cannot be used unless new and less expensive methods of treating it can be devised. The bast fibre represents only about 8–10 per cent of the dry weight of the nettle stem, so it can be seen at once that a considerable amount of material is likely to be wasted unless methods of preparation can be improved, or an alternative use found for the by-products. It is also important to emphasize that the quantity of available nettles is never likely to be sufficient to satisfy more than a small fraction of the paper requirements of Great Britain. The most promising line, therefore, would appear to be to make good-quality paper for special purposes. Whether it would be economically possible in Great Britain to use nettle fibre for textiles as in Germany needs further investigation.

It is not generally known that differences in the standard of living in Great Britain and Central Europe respectively made it economically possible to import dried stinging nettles from the Continent before the War. This material was used for the extraction of chlorophyll, which is employed to give a green colour to soap and other toilet preparations and, to a limited extent, in medicine. Nettles are more favourable than other plants as raw material for this purpose owing to the ease with which the chlorophyll may be extracted, as well as to the desirable shade of green which it exhibits. A great deal of the chlorophyll used in Great Britain before the War was imported ready-made from the Continent. It will be interesting to see whether, after the War, economic conditions will be such as to enable or make it desirable for us to import this material again.

There is, meanwhile, an admirable opportunity to extract chlorophyll for export to those countries which, like ourselves, were previously supplied from the European Continent. The desirability of effective collaboration between those who cultivate nettles for fibre and those who wish to use the leaf for the extraction of chlorophyll is clear for all to see. We might also emulate the German skill in using *Ersatz* material by devoting any excess of leaves to the feeding of cattle, even if the well-known value of young nettles as human food fails to command much popular respect. It is interesting to note in this connexion that the protein content of the nettle is high.

[1] Ulbrich, E., "Fasern" in "Ersatzstoffe aus dem Pflanzenreich", edited by L. Diels, Stuttgart, 1918, 318–87. Pp. 355–63 deal with the fibre of *Urtica dioica*.

[2] Anon., *Jute Abstracts*, 3, 9, 235.

OBITUARIES

Prof. G. A. Reisner

THE death on June 6 last of George Andrew Reisner, professor of Egyptology at Harvard University, has removed from our midst one of the greatest and most successful excavators Egypt has ever known. His rival for the foremost place could indeed only be Sir William Flinders Petrie, his senior by some ten years, who is happily still with us. To assess the comparative merits of these two would be invidious, but a few sentences may perhaps attempt to sum up the special merits of each. Petrie has been essentially the pioneer. Before him, excavation was but a haphazard affair; no attention paid to detail, often in fact left to untrained native foremen. Petrie's field-work, starting full fifteen years before that of his American colleague, was the first to inaugurate careful planning of sites, with complete recording of pottery and smaller objects; and the prompt annual publication of results has been the greatest boon to our science. It cannot be gainsaid that Reisner greatly improved upon Petrie's methods. Never has there been such meticulous regard to the smallest objects, photography applied at every stage, the most careful training and organization of the workpeople, voluminous notes compiled with unremitting patience; and scholarly philological training at the back of it all. Alas, the inevitable consequence of such minuteness has been that publication has often been unduly deferred. Reisner's books are fairly numerous, always bulky, but their content covers only a fraction of the work that he achieved. It is devoutly to be hoped that those into whose hands his material now passes will repair the miscalculation here deplored. Thus only shall we be enabled to measure the full stature of the man, and derive complete profit from the astonishing achievements of his career.

From early work on cuneiform tablets, for which he received his training in Berlin, Reisner soon switched over to Egyptian studies, and in 1899 took charge of the Hearst Egyptian expedition to Upper Egypt. Here he unearthed important cemeteries of the early periods, especially at Naga ed-Dêr, near Girgah. In 1905 began the excavations on behalf of Harvard University which were continued down to his death, interrupted only by the three years spent in charge of the Egyptian Government Survey in Nubia (1907–9). Investigations in various Nubian cemeteries led on to excavations much farther south, when the tombs of many late Ethopian kings were discovered, and a most interesting settlement of Middle Kingdom date explored at Kerma. Two seasons at Samaria (1909–10) brought to light the palaces of Omri and Ahab, with many important remains.

But it was in the neighbourhood of the Pyramids of Gîzah that Reisner scored his greatest successes. The laying bare of the temple of the Third Pyramid resulted in the discovery of marvellous statuary, chief among which was the great slate group now in Boston of King Mycerinus and his mother. Even more valuable were the results of the excavations around the Great Pyramid. Here the symmetrically laid-out necropolis city of the nobles and princes of the time of Cheops was systematically investigated, the crowning find being that of the secret burying-place of that Pharaoh's mother, Queen Ḥetepheres. The chaste sobriety of the magnificent furniture found in this untouched burial forms a remarkable contrast to the far richer, but sometimes garish, treasures from the Theban tomb of Tutankhamūn, the most sensational archæological discovery ever made.

This inadequate account cannot conclude without a brief impression of the man himself. He was an American of the Americans. With his powerful figure and forthright utterance he reminded one of Theodore Roosevelt, but hand in hand with these somewhat awe-inspiring characteristics went a kindness and hospitality unforgettable for those who, like the present writer, often benefited by them.

ALAN H. GARDINER.

Mr. C. C. A. Monro

CHARLES CARMICHAEL ARTHUR MONRO, who died on June 21, came of a Scottish family that has had many distinguished members. It included three generations of professors of anatomy at the University of Edinburgh, all bearing the name of Alexander Monro, the second of whom (1733–1817) has given his name to the "foramina of Monro", which connect certain ventricles of the vertebrate brain. His great-grandson, David Binning Monro (1836–1905), was provost of Oriel College, Oxford, and a well-known Homeric scholar. Charles Monro was born in India on September 14, 1894, the younger son of the late Alexander Monro, who was director of public instruction, Central Provinces, and whose elder son, Alexander Monro, has also had a distinguished career in the Indian Civil Service. An uncle, the late General Sir Charles Monro, was commander-in-chief at the Dardanelles in 1915, and afterwards Governor and commander-in-chief of Gibraltar.

Monro was educated at Charterhouse, Eton (where he was a King's scholar) and Trinity College, Oxford. Going up to Oxford in 1913, he took Pass Moderations in Classics in 1914, and began to read for the Honour School of Lit. Hum. His studies were, however, interrupted by the outbreak of war. He served in France and Belgium, and was wounded and suffered shell-shock in 1916. Returning to Oxford in 1920, Monro, who had become interested in zoology, decided to read for the Honour School of Natural Science in that subject, and did so until 1922.

After brief experiments in business and agricultural practice, Monro was appointed in November 1922 to an assistant keepership in the Department of Zoology, British Museum (Natural History), and was placed in charge of the collections of Annelids and Echinoderms. While doing a good deal of curatorial work on these collections, and being responsible for their removal from the Old to the New Spirit Building of the Museum in 1924, he devoted his attention mainly to the Annelids, and in particular to the Polychæte worms. In the course of the years 1924–39 he published some thirty-seven systematic memoirs, many of which were important contributions to the subject. They included, besides smaller papers, extensive reports on the large collections obtained by the *Discovery*, Great Barrier Reef, John Murray and B.A.N.Z. Antarctic Research Expeditions, as well as reports on collections made by smaller expeditions (*St. George*, *Rosaura*, etc.). There can be no doubt that Monro was well on the way to become a leading authority on the Polychæta. An interesting investigation of his was that on a species of Serpulid new to British waters, which he named *Hydroides incrustans*. This was found forming extensive incrustations in an enclosed harbour canal in Sussex.

where, owing to the discharge of hot sea-water from a power-station, the temperature of the water was many degrees higher than in the adjacent part of the English Channel. Monro felt some uncertainty whether the worms represented a species accidentally introduced on the bottom of a ship from a warmer climate, or whether the high temperature of the water had produced a neotenic race of a widely distributed species, *Hydroides norvegica*, showing well-marked differences in size and structural details from the typical form.

In one of his shorter papers Monro discussed the need for a re-classification of the Echiuroidea, and made some important proposals for the rearrangement and redefinition of the families and genera of that group. He was responsible for the reorganization of the starfish gallery of the Museum in 1928, and also rearranged the study collection of echinoderms in accordance with modern classification. Almost the whole of the "General Guide to the Exhibition Galleries", published by the Museum in 1931, was written by him. He edited, for publication by the Museum, a series of postcards dealing with the old herbal "Hortus Sanitatis", a task in which his considerable knowledge of medieval Latin proved of great value. One of his last official duties at the Museum was the preparation, jointly with the present writer, of a new "Collectors' Handbook" dealing with the collection and preservation of invertebrates other than insects. He wrote the section on Vermes in the "Standard Natural History" (1931), and articles on several groups of annelid worms in the Encyclopædia Britannica (14th edition). For about two years (1925–27) he was editor of the *Museums Journal*.

Soon after the outbreak of war, Monro's services were lent to the Ministry of Food, where he worked until his last illness. He had been seriously ill in 1935, and had undergone a severe operation. From that illness he had never completely recovered, and a second operation was performed a few weeks before his death. He possessed great charm of personality and a very open and upright character. He was a pleasant colleague and a good-natured companion, with a strong sense of humour and an acute and well-informed mind. Somewhat of a rebel, from his school days, against convention and what he considered social injustice, he was also interested in many aspects of learning and the arts, and was a man of very considerable culture and wide reading. He had a great love and understanding of poetry, and was deeply interested in theology and metaphysical philosophy. He always took a great delight in intellectual discussion, and many, no doubt, will remember a lecture delivered by him at a summer school at Cambridge in 1939 on the relation between science and religion. It seems to have been a desire to understand the deeper mysteries and problems of life that urged him to the study of biological science, and the same desire that led him, when already in his thirties, to embrace Catholicism, to which he was a fervent convert. He was keenly interested in the Neo-scholastic philosophy and in foreign politics, and was for a time honorary secretary of the Catholic Council for International Relations.

Until his health became seriously impaired, Monro had unbounded vitality and love of life, and of the good things it had to offer. His recreations included walking, swimming, yachting, fishing, shooting and fencing. For some years he was a leading exponent of the épée, being once runner-up in the British championship and one of the British representatives in a European tournament at Le Touquet. But above all he loved the open country and the hills, and most of his holidays were spent in walking in the Lake District, in Wales or in the west of Ireland. As a boy he had spent a number of holidays in France, acquiring a fluent knowledge of the French language, and an affection for the country and its people which he never lost.

Monro was twice married; first, in 1917, to Pamela Gartside Tipping, by whom he had one son (a captain in the Gordon Highlanders, missing at Singapore), and secondly, in 1927, to Sheila Mary Anderson, who, with their two young sons, survives him.

H. A. BAYLIS.

DURING an acquaintance with Monro extending over some twenty years I have had, in common with many other zoologists, occasion to regard him with much gratitude, admiration and affection. In an era when good systematists are becoming lamentably scarce, Monro stood out as an example of the ideal systematic worker. His systematic knowledge of the Polychæta, in the first place, was wide, accurate and of an intelligent type, and coupled with the mass of detail at his finger-tips connected with the literature of the subject and the diagnostic features of the species contained in the group was a particularly useful acquaintance with their distribution and geographical relations.

Although dealing almost entirely with preserved material himself, Monro was always keenly interested in receiving news of the living animals and actively aware of the importance of their ecological relations. He was always thoroughly willing to assist ecologists by determining their material, and did it promptly and in the most helpful way. My personal gratitude to him was elicited by the assistance which he gave me in ecological work carried out during the Barrier Reef Expedition and during ten years of marine studies in South Africa. Among a group of systematists whose kind services made it possible to work out the results of these studies at all, Monro was outstanding as one of the most actively helpful: in fact, he was a member of that rather small class, the 'perfect systematists'. This was the more so because, as so many of his friends are aware, Monro was a personality of great liveliness apart from his official work altogether. Very widely read and capable of talking entertainingly and yet with balance on almost any subject, and possessed of abilities quite distinct from those required for his museum work, he was a very fully developed human being and a most welcome companion.

T. A. STEPHENSON.

Prof. Joseph Paczoski

JOSEPH PACZOSKI, professor of the University of Poznan (Poland), who died on February 14, was a distinguished taxonomist and the founder of a new branch of botany, phytosociology. We do not know all the details concerning the last period of his life under German occupation in Poland; one can imagine, however, how much he must have suffered. At the beginning of the War in Poland, immediately after Poznan had been occupied by German troops, nearly all the university professors were arrested there, they were deprived of all their personal possessions, deported to the so-called General-Gouvernement and left to starve. This was also the fate of the 77-year-old Prof. Paczoski.

Joseph Paczoski was born on December 8, 1864, in Bialogrodka (Wolhynia). He was educated at the Agricultural School in Human (Ukraine) and afterwards studied and was assistant under the well-known Prof. Schmalhausen at the University of Kief (1888–94). He then held successively various posts. He was custodian of the Botanical Garden of St. Petersburg (1894–95), assistant at the Agricultural College of Dublany near Lwów (south-eastern Poland) (1895–97), director of the Natural History Museum at Cherson (Ukraine) (1907–20), founded by himself, director of the Steppes Preservation of Ascania Nova (1922–23). After the outbreak of revolution in Russia, Paczoski refused the very good facilities for scientific work offered him by the Soviet Government and left Russia for Poland. There he was appointed director of the National Park in Bialowieza (1923–28) consisting of primeval forest. At the same time he was professor of taxonomy and plant-geography at the University of Poznan. During about fifty strenuous years he published more than two hundred scientific papers and articles. These works have earned him a place among the best-known men of science in Europe.

When engaged in the study of the flora and of plant-geography he spent most of his time on excursions to many places ranging from the Baltic to the Adriatic Sea and eastwards to the Volga.

No other Polish botanist, and only a few from other countries, have succeeded in investigating such wide areas as Prof. Paczoski. He was considered to be the most outstanding investigator of the flora of south-eastern Europe. Prof. Paczoski was the originator of a new branch of botany, phytosociology. Until a few years ago men of science of western Europe had to refer in phytosociology to the treatise by M. R. Harper, "The New Science of Plant Sociology" (1917). Still more recently Russian botanists with their tremendous enthusiasm have occupied the first place in the development of phytosociology, after having rightly acknowledged the great merits of Prof. Paczoski, the Polish pioneer in this field (W. W. Alechin: "Wann und wo ist die Phytosoziologie entstanden ?", Botaniska Notiser, Lund, 1924). It is more than fifty years since Prof. Paczoski published his work "Stages in Flora Evolution" (Russian, Wiestnik Jestiestwoznanja, St. Petersburg, 1891). There he laid down the principal outlines of phytosociology so clearly that to-day nothing more can be added or abstracted from these. The term 'phytosociology' was used for the first time in his next work "The Social Life of Plants" (published in the Polish magazine *Wszechswiat*, Warsaw, 1896). By giving the outlines of and a name to the new science Prof. Paczoski deserves a permanent place in the history of phytosociology. As acknowledgment of his great merits, the Polish Botanical Society reprinted his "Social Life of Plants" in the "Biblioteka Botaniczna", vol. 2, Cracow, 1930, published in Polish and English. The term 'phytosociology' has been used by the following authors in chronological order: J. Paczoski in 1896, P. Krylow in 1898, W. Sukaczew in 1915, M. Harper (United States) in 1917, in Scandinavia and Western Europe in 1919.

Researches made in Bialowieza directed his attention to the relation between the number of trees and diameter of the trees at 1·3 m. (to about 4 ft. 3 in.) in pure and mixed woods respectively. Paczoski's curves for the primeval and thinned forests are based on these measurements. These methods have been termed by Paczoski "biological structure of forests". After further investigation they will be of practical importance in forestry. Results have been published in the Polish Forestry Society's Journal *Sylwan* printed in Lwów, and in the standard work "Forest of Bialowieza". In 1930 Paczoski was sent by the University of Poznan to Yugoslavia and Bulgaria for special forest investigations. His very interesting results were published in *Sylwan*.

Prof. Paczoski's death is a serious loss not only to Polish science but also to the scientific community throughout the world. S. B

The Right Hon. Lord Glanely

THE RIGHT HON. LORD GLANELY, whose death occurred on June 28 as a result of enemy action, was president of the Court of Governors of the University College of South Wales and Monmouthshire. A Cardiff shipping magnate and head of the Tatem Shipping Company, he had always maintained a special interest in University College, Cardiff. After the War of 1914–18, when a special appeal was launched for the completion of the buildings on the new site in Cathays Park, he made a magnificent donation of £100,000 to that fund. This was allocated to the provision of the "Tatem Chemical Laboratory" and to the erection of a wing of the College to be devoted to the study of agriculture, a subject in which the late Lord Glanely was specially interested. This wing now houses the Advisory Departments of Agricultural Zoology, Agricultural Botany and Veterinary Science. In 1930 Lord Glanely made a gift of £2,000 to found two scholarships in memory of his wife, to be awarded in the first place to the children of parents who are or have been employed at or about Cardiff Docks. In this way he indicated his special interest in the welfare of the workers in the industry from which he derived his fortune. At the time of his death Lord Glanely was serving his third five-year term of office as president of University College, Cardiff. The College mourns the loss of a generous benefactor whose sympathy for, and interest in, its progress had extended over twenty-five years, the most difficult and important in its history.

WE regret to announce the following deaths:

Prof. Raymond Dodge, emeritus professor of psychology at Yale University, member of the U.S. National Academy of Sciences and president in 1916–17 of the American Psychological Association, on April 8, aged seventy-one.

Mr. E. C. Groesbeck, metallurgist of the Division of Metallurgy of the U.S. Bureau of Standards, on May 8, aged sixty-one.

Mr. G. C. Lloyd, secretary of the Iron and Steel Institute during 1908–34, on July 10, aged eighty-one.

Mr. W. F. Reynolds, chief of the Section of Triangulation of the Division of Geodesy of the U.S. Coast and Geodetic Survey, on May 1, aged sixty-one.

Prof. John Harrison Skinner, professor of animal husbandry and dean emeritus of the School of Agriculture of Purdue University, on April 28, aged sixty-eight.

Prof. A. N. Talbot, professor of municipal and sanitary engineering in the University of Illinois, on April 3.

Prof. W. H. Young, F.R.S., formerly professor of mathematics in the University of Wales, aged seventy-eight.

NEWS and VIEWS

National Institute of Agricultural Engineering

THE Institute for Research in Agricultural Engineering, University of Oxford, has been taken over by the Ministry of Agriculture to form the nucleus of a new national institute which has been established at Askham Bryan, near York. The general function of the National Institute of Agricultural Engineering will be to foster the development and better utilization of agricultural machinery of all kinds. Its work will be organized in three main departments. The Agricultural Department will provide a clearing-house for information about machines and methods for the benefit of both farmers and manufacturers; and will aim both at bringing equipment needs to light and at suggesting the means by which they can be met. The Engineering Department, which is to be adequately equipped with drawing office and workshops, will be concerned directly with design and improvement. In the case of new inventions, it will provide the necessary link between the original idea and the device which is ready for development, by undertaking the final stages of design and constructing prototype machines. The Field Station Department will be equipped to carry out whatever tests, trials or demonstrations may be required. One of its main duties during wartime will be to try out, adapt and demonstrate in other districts, labour-saving devices and methods which individual farmers up and down the country have worked out for themselves. The Institute will be guided in its work by the Agricultural Machinery Development Board, which was set up earlier in the year under the chairmanship of Lord Radnor. The director of the new Institute is Mr. S. J. Wright, formerly director at Oxford.

Planned City Growth

THE extent to which Mr. F. J. Osborn's admirable statement of the main essentials of planning, so far as they affect the ordinary citizen, originally written in 1918, is still valid to-day is a tribute to his powers of analysis and exposition (New Towns After the War. By F. J. Osborn. Revised edition. Pp. 72+8 plates. (London: J. M. Dent and Sons, Ltd., 1942. 4*s*. 6*d*. net.) It is also at least in part a reflection upon the general failure to apply those principles or even to learn from the bitter experience of the decade after the War of 1914–18. On both counts the 1942 edition deserves a warm welcome, and the new matter included, notably the illustration of the way in which Welwyn Garden City exemplifies the original thesis or formula, and the brief but well-chosen book list, enhance its value. The book is a concise re-statement of the argument for building new industrial towns, surrounded by country belts, as part of the reconstruction programme. Stressing the necessity for a national plan and criticizing the absence of policy which permitted the expansion of a few great cities at the expense of the countryside and of the smaller towns of Britain, with grave effects on the lives of town-dwellers and the efficiency of industry, it outlines broadly a policy commensurate with the needs of the time, the soundness of which is emphasized by the fulfilment of many of the author's predictions as to the trend of unplanned city-growth.

The close connexion of housing with public health, with transport, with problems of industrial and agricultural organization, with child welfare and education, national and local government and every aspect of the civic and cultural life of the community, leads Mr. Osborn to insist that there is a maximum size for a modern town. He advances the formula that a town should be of a population large enough to allow of efficient industrial organization and full social activity, but no larger. The urban area should be limited to a size requisite to house this population well, and should be surrounded by a zone of open land large enough to possess a distinctively rural and agricultural character. The whole of the land, including the urban area and the rural zone, should be owned and administered in the interest of the community. The application of this formula is well illustrated by reference to Welwyn Garden City, the foundation of which by Sir Ebenezer Howard in 1919 was an outcome of the original publication of the book. Mr. Osborn directs attention to the importance of some of the special problems involved, such as the location of new cities in relation to rural needs, some of which, like that of general control and liberty of individual taste in design, have not yet been fully thought out. The conditions of State support are indicated and Mr. Osborn gives an inspiring glimpse of the possibilities inherent in developments on these lines if the opportunities are used by creative minds alive to the social issues involved.

Dr. A. Yakubov

MELIK-PASHAYEV, chief geologist to the Azerbaidjan Oil Combine, has recently provided the Press Department of the Soviet Embassy in London with some interesting information concerning the career of Akhad Yakubov, vice-chairman of the Azerbaidjan Branch of the Academy of Sciences of the U.S.S.R. As a young man Yakubov's overriding aim was to master the science of geology and place his knowledge at the service of his country. More particularly was he concerned with the applications of geology to the economic exploitation of petroleum deposits. Experience as a technician in the oil fields of Baku and later at Lokbatan gave him a sure practical knowledge of the oil industry, which was implemented by his studies at Azerbaidjan Industrial Institute and at the Azerbaidjan branch of the Soviet Academy of Sciences, where he took his doctor's degree in geological and mineral sciences with honours. While in charge of oil extraction at a new field which was being developed on the slopes of Lokbatan mud volcano, Yakubov became convinced of the fallacy of the then widely held belief that mud volcanoes were incompatible with oil-bearing strata.

Detailed studies lasting over a period of ten years confirmed Yakubov in this view, and between 1934 and 1941 he published eight books elucidating the connexion between mud volcanoes and oil deposits. Summarily, Yakubov believes that "mud volcanoes are a direct indication of the existence of oil- and gas-bearing deposits" and that "the distribution of oil and gas is determined by the same laws as operate in regions where there are no mud volcanoes". His work considerably increases prospects of oil discovery in Azerbaidjan and is of immense practical value in the prosecution of the war against Germany. Early this year Yakubov was decorated with the Order of Lenin and afterwards was awarded a First Stalin Prize. Born in 1908, he is now at the height of his creative powers and plays a leading part in the scientific, political and public life of his country.

Bagasse for the Manufacture of Paper and Board

THE many attempts to utilize bagasse for the manufacture of paper have met with varying degrees of success, partly for economic reasons and partly because the nature of bagasse often renders it suitable only for relatively low-grade products. M. P. Bhargava and A. N. Nayer, of the Dehra Dun Forest Research Institute, have, however, recently approached the problem from the other extreme, namely, that of the manufacture of boards, and in particular of insulation and pressed boards, a large potential demand for which exists in India (*Imp. Council of Agric. Res., Misc. Bull.*, No. 44; 1941). The various processes available for the purpose were studied, but defibration in an Asplund-type machine was favoured on the grounds of the low installation and operating costs and of the quality of the product. The cost of afterwards rendering the boards resistant to moisture, fire and insects appears, however, to be disproportionately high. The samples accompanying the bulletin and the test data published in it suggest that, technically, the process is a promising one. The sample of bagasse wrapping-paper also sent is, however, less impressive; no test data are given, but obviously the fibre length is short, which means low tearing and folding strengths.

A New X-Ray Photographic Paper

MESSRS. ILFORD, LTD., have recently placed on the market, under the name 'Kryptoscreen', a new X-ray paper incorporating its own intensifying screen. Underneath the sensitive emulsion is a layer of extremely fine white pigment which fluoresces under the influence of X-rays. The blue-violet light emitted shortens exposure times and much improves the gradation of radiographs made on the paper. The search for a cheap fluorescent material which neither lowers the sensitivity of the photographic emulsion nor impairs definition has been carried on for many years by the Ilford Research Laboratories. The resulting product provides an economical substitute for film in the radiography of fractures of the extremities and in certain types of industrial radiography. The same fluorescing material has been used to make a 'Brytex Intensifying Leaf' of exceedingly fine grain and medium intensification factor. When both screen and paper are used together, a reduction in exposure to one third of that needed by Kryptoscreen paper alone is possible without any loss of definition.

A New British Orchid

THE flora of the duneland area between Liverpool and Southport (botanically "south Lancashire", vice-county 59, but in all official and local nomenclature "west Lancashire") has always interested botanists well outside the local area owing to the many special forms of plants adapted to the peculiar habitat, and as a subject for plant ecology it much resembles the Flanders coast. Its list of sixteen Orchidaceæ is a special attraction and this has now been extended by the discovery and naming of a new species, *Epipactis pendula* (C. Thomas, *J. Bot.*, Dec., 1941) previously regarded by local botanists as *E. dunensis* (Godfrey, "British Orchidaceæ"; Green, "Flora of Liverpool"), which in turn had for years been locally considered but an early-flowering variety of the common broad-leaved helleborine, *E. latifolia*, but with smaller, greener, less-expanded flowers. The new species was found and described in some numbers from Formby and appears to prefer the clearings by the woods, whereas *E. dunensis* proper is more typical of the open dunes.

In 1934 two Liverpool naturalists, Green and Hardy, made a floral survey of these dunes for Flora's League in the hope of creating a plant sanctuary, and this orchid was noted growing abundantly in and by the thinner pinewoods, but it was regarded as a woodland variation of *E. dunensis*. The description of the new species notes as characteristic its sturdy growth, small, opposite, arched and wavy-edged leaves, raceme of numerous pendulous flowers often tinted brown on the outside, flowers large and frequently wide open; of forty-five plants at Formby a few had more than one flowering stem. The type is in the British Museum herbarium. If all the plants previously thought to be woodland forms of *E. dunensis* are the new species it seems safe from extermination, and was possibly evolved from *E. dunensis* since this coastal area was afforested in 1889.

Ultra-violet Radiation

A SUMMARY of the uses of ultra-violet radiation with special reference to lethal effects is given by J. R. Harris in the *Electrician* of July 10. The 'near' ultra-violet region, 3,200 A. to 4,000 A., is used for photographic and fluorescent effects, the source generally being the ultra-violet 'black' lamp, which emits a maximum radiation at 3,650 A. The 'middle' band, 2,800 A. to 3,200 A., represents the therapeutical region which produces erythema; lamps emitting this radiation are the so-called sunlamps and are widely used as a tonic treatment in welfare centres. Rays in the 'far' ultra-violet region, 2,000 A. to 2,800 A., are lethal to bacteria; the most suitable source is the quartz mercury-vapour discharge lamp large numbers of which are used in the United States for sterilizing.

The lamps have been given the following applications. Germicidal lamps have been installed in air-ducts, particularly those of air-conditioning schemes. In the ward of a children's hospital, germicidal lamps have been placed in concentrating reflectors and mounted on the ceiling between the cots to prevent the free passage of bacteria by the presence of the invisible 'lethal' curtain. Lamps have been installed with successful results in a mattress factory for sterilizing the cotton, the method proving cheaper than sterilizing by placing the cotton in a room containing formaldehyde fumes. A New York hotel recently purchased a specially constructed unit of four 15-watt germicidal lamps for use in bathrooms, the whole unit being designed so that the ultra-violet rays reach the floor and walls; the lethal efficiency is stated to be 99 per cent. Small sources have been installed over the counter of a bank so as to produce an invisible 'purification wall' between cashiers and customers.

A New Circuit Continuity Test

A. F. BURNS, in an article on testing of the crossbar system of telephony (*Bell Lab. Rec.*, **20**, No. 9; May, 1942), points out that in dialling systems a talking connexion is established through a large number of contacts, and it is desirable to test for ensuring that after the circuit is closed through to the called subscriber, there will be no open circuits in the offices through which the call passes. With the crossbar system, the sender makes a continuity test

at the calling office and at the originating office, but it was found to be impracticable to provide a suitable routine testing procedure for the terminating office because of the multiplicity of paths that any particular call might follow. It was decided, therefore, to arrange the terminating marker to apply a continuity test for each call to make sure, before it is disconnected, that a circuit is completed to a subscriber line.

Briefly, the method consists in sending grounded 20-cycle current through the central-office contacts, out on one side of the subscriber line, through the station ringer, or signal, and to ground either at the subscriber station or at the central office. The difficulty associated with widely varying circuit capacitances and resistances was overcome by taking advantage of the difference in phase between the current flowing through the office capacitance and that flowing over the subscriber line, which latter is chiefly resistive under extreme conditions. In the extreme case, when the ground capacitance is zero and the circuit is closed, the current that flows is in phase with the applied voltage, whereas when the capacitance from the 20-cycle supply to ground is a maximum and the circuit is open, the current flowing is 90° out of phase with the applied voltage. An open circuit with high leakage may thus draw more current than a closed circuit with low leakage, but the angular displacements of the currents with respect to the applied voltage are very different. The new test is based upon this fact, and current flowing in the test circuit is determined from the voltage drop across a condenser in series with the subscriber line. The article describes the test circuits and apparatus in detail and indicates the criteria governing the test.

Philosophy in the *Philosophical Magazine*

ALTHOUGH physics is regarded as one of the exact sciences, exactitude was not always found in the titles of its journals. For many years *Science Abstracts* was regarded as an adequate title for the journal now known as *Physics Abstracts*, and the *London, Edinburgh and Dublin Philosophical Magazine and Journal of Science* has published many more papers in physics than in philosophy. In the May number of the latter, however, four of the seven papers are mainly philosophical. Prof. E. T. Whittaker gives a stimulating discussion of "Some Disputed Questions in the Philosophy of the Physical Sciences", using well-chosen analogies. Attention is naturally given to the attempts of mathematicians to discover 'facts' without the use of experiment or observation. As mathematical symbols are not used, the paper is suitable also for the general reader. The other three papers deal with the thorny subject of dimensions. In a brief note, Dr. Norman Campbell points out that writers on the subject are apt to ignore much of the vast literature because "anyone who attempted to summarize the literature would become involved in so many controversies that he could get no further". Since assignment of dimensions is a means to an end, and not an end in itself, writers are urged to state explicitly what end they have in view and how that end is served by the considerations presented in their writings. In a paper of twenty-four pages, Prof. H. Dingle attempts to relate the subject to more fundamental and universally acceptable ideas. Twelve definitions and postulates are given as a set of principles upon which discussion of dimensions may be based. The third paper, by Dr. G. B. Brown, is a reply to some criticisms of Prof. Wilson upon a recent paper on dimensions published originally in the *Proceedings of the Physical Society*, **53**, 418 (1941).

Potentialities of the Forests of Latin America

PROF. S. J. RECORD of the School of Forestry, Yale University, raises the question of the utilization of the "enormous areas" of potentially commercial forest in Latin America in a brief article in *Tropical Woods* (No. 70. Yale University; June, 1942) that deserves wide consideration. He points out the reasons for the lack of demand for tropical lumber. Tropical timbers are different from those growing in the north temperate zone; they may not be inferior but their technical properties are unknown to the consumer. Private commercial concerns naturally do not face the trouble and expense involved in trying out the utility of the new wood for their purpose and they have no guarantee of continuity of supply of the new type. The plain lack is that of subsidized laboratory facilities to make pilot tests on the utility of available timber, to trace defects in supply to their source, to encourage good forestry management and exploitation and to educate the trade in the utilization of the new wood in manufacturing processes. Prof. Record concludes: "Science and Engineering together can find a way to use the tropical forest as a whole and make it a perpetual source, not only of plywood and lumber, but also of unlimited quantities of cellulose, a basic material with a myriad actual and potential applications in industry."

Discovery of the North American Flora

MANY kinds of trees and shrubs now used in forestry and gardening owe their introduction to the pioneer journeys of David Douglas (1799–1834). These early botanical explorations form the subject of a recent paper by F. R. S. Balfour (*J. Roy. Hort. Soc.*, **67**, Parts 4 and 5; April and May, 1942). Douglas's journey to the North Pacific Coast in 1824 was backed by the Royal Horticultural Society, and resulted in the introduction of such garden favourites as *Ribes sanguineum* and *Berberis aquifolium*. New conifers were later discovered, namely, *Pinus nobilis*, *P. amabilis*, *P. lambestiana*, *Larix occidentalis*, *Thuja plicata* and many others. Neither shipwreck nor illness deterred this intrepid botanist, and while most of his journeys were made in North America, he met a rather strange death during a journey in Hawaii.

Cancer Control

AN annotation in the *Journal of the American Medical Association* of April 18 states that since a cancer control programme was inaugurated fifteen years ago in Massachusetts, about 14,000 patients with cancer, 40 per cent of whom are still alive, have attended the special clinics for the disease. 80·8 per cent of the patients were referred by medical practitioners to the clinics as compared with only 20·1 per cent in the first year of the programme. Between 1927 and 1935, 421 medical men used the tumour diagnostic service as compared with 798 in 1940. As regards the education of the public, the delay between the time of the first recognized symptom of the disease and the time that the patient obtained

medical advice averaged 6·5 months in the early years of the programme, whereas between 1936 and 1939 it was 5·3 months and in 1940 4·6 months. In 1932, 31·1 per cent of the fatal cases had never been treated in a cancer hospital, while in 1940 this figure was reduced to 15·6 per cent, indicating that hospitalization for cancer is increasing far more rapidly than cases of the disease.

Biology in Brazil

WE welcome the appearance of No. 1 (March, 1942) of Vol. 2 of the *Revista Brasileira de Biologia*, the official organ of the Biological Society of Brazil. The issue runs to 133 pages and contains seventeen papers covering a very wide field of biological subjects including medicine and parasitology. Thus, P. W. Wygodzinsky describes new species of insects of the orders Diplura and Thysanura from Palestine: J. R. Valle and P. R. Souza discuss observations concerning the endocrine system of eighty-four ovoviviparous snakes, and especially the corpora lutea; and F. Feigl and H. Cardoso write on tests for the identification of ascorbic acid. Each volume of the journal is to contain about five hundred pages, comprised in four parts issued in March, June, September and December. The subscription outside Brazil is 4 U.S. dollars, which should be sent to the Secretario da Comissão de Redação, Mario Vianna Dias, Caixa postal 1.587, Rio de Janeiro, D.F., Brazil.

Health of Ceylon

ACCORDING to the report of the Director of Medical and Sanitary Services, Ceylon, in 1940, malaria, as in previous years, was the most prevalent disease in the island, about 97,000 cases having been treated in hospitals and 2,994,000 in dispensaries. The chief outbreak occurred in the south-west early in May and continued until the middle of July. In the north-western province an epidemic of dysentery, due to the Shiga bacillus, also started in May. During the year the leprosy survey which was begun in 1933 was completed. The total number of patients was 2,771—2,032 males and 739 females—of whom more than a thousand were segregated in two leper asylums. The whole population of Ceylon is estimated at 5,951,000, The total births in 1940 numbered 212,982, a rate of 35·8 per 1,000; deaths amounted to 122,738, a rate of 20·6. The infant mortality-rate was 149 per 1,000 and the maternal rate 16·1.

Aphids

A SHORT paper by G. Fox-Wilson (*J. Roy. Hort. Soc.*, **67**, Pt. 6; June, 1942) reviews the horticultural significance and control of aphids. Eradication of these pests is often difficult, and one of the reasons is discussed in the paper. Viviparous stem mothers, when subjected to certain contact insecticides, often remain in a comatose state before death actually occurs, but living nymphs are often produced in this condition. Spraying with nicotine is the best control, but Derris and Pyrethrum washes should be employed where the plant parts attacked are to be used for food.

Physics Bibliography

THE vital importance of the library as a part of the equipment of a research laboratory is implicitly acknowledged in the *Review of Scientific Instruments* by the attention given to the current literature of physics in each number of the journal. Twice a year special book numbers are issued, and the spring book number (**13**, No. 4, April, 1942) contains twenty-four pages devoted to reviews of thirty-eight books on physics. In addition, a two-page "Condensed Library Guide for the Physicist" gives a summary of the standard sources of reference. Copies of the list for the use of students can be bought in quantity from the American Institute of Physics, 175 Fifth Avenue, New York. The list serves as a reminder of the extent to which physics lags behind chemistry in bibliography. The usual monthly survey, "Current Literature of Physics", deals with the research journals. The latest reference to an English journal appears to be that to the issue of NATURE dated February 7.

Announcements

IN pursuance of the decision of the Secretary of State for the Colonies to open the administrative service in the Gold Coast to Africans, Mr. K. A. Busia and Mr. A. L. Adu have been selected as assistant district commissioners in the Gold Coast. Mr. Busia, an Ashanti, was born in 1913. He was educated in the Gold Coast, where he graduated in 1939, and at University College, Oxford, where he obtained a B.A. degree. Mr. Adu, a member of the Twi tribe, was born in 1914. He attended schools in the Gold Coast, and afterwards went to Queens' College, Cambridge, where he took a degree in natural science.

THE following have been elected to fill vacancies which will occur on the Council of the Institution of Electrical Engineers on September 30 next: *President*, Prof. C. L. Fortescue; *Vice-President*, Mr. P. Good; *Hon. Treasurer*, Mr. E. Leete; *Ordinary Members of Council*, Prof. J. D. Cockcroft, Mr. A. J. Gill, Mr. D. B. Hoseason, Dr. A. H. Railing, Mr. E. A. Reynolds, Mr. H. W. H. Richards, Mr. J. M. Fleming and Mr. C. W. Bridgen.

AN extensive list of institutions, societies and research workers in the pure and applied plant sciences in Central and South America has been prepared by the editors of *Chronica Botanica*, in co-operation with the Division of Agriculture of the Office of the Co-ordinator of Inter-American Affairs, Washington, D.C. The list has been published in *Chronica Botanica*, **7**, No. 2 and 3, March and May, 1942 (*Chronica Botanica* Co., Waltham, Mass.). There are about two thousand names in the list, which is the first of its kind.

SCHUMAN'S, of 20 East 70th Street, New York, have issued a catalogue entitled "Medical Miscellany List E". Attention may be directed to the following items: the "Compendium Artis Medicæ" of Bertucius *alias* Bertuccio or Bertrutius (1537), the "Libri duodecim" of Alexander of Tralles (1556), the "Opuscula anatomica" of Eustachius (1563–64), the first edition of John Hunter's "Treatise on the Venereal Disease" (1786), Morgagni's "De Sedibus et causis morborum" (1820–23), and various early works on anæsthesia. A section on military medicine contains notice of the following important works: George James Guthrie's "Commentaries on the Surgery of the War in Portugal, Spain, France and the Netherlands" (1862), Woodward's "Report on Epidemic Cholera, and Yellow Fever in the Army of the United States during the year 1867" (1868), George M. Sternberg's "Sanitary Lessons of the Spanish-American War" (1899), and Cabanè's "Chirurgiens et blessés à travers l'histoire" (1918).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Interrelationship of Vitamins A and E

THE effect of vitamin E in preserving vitamin A in oil solution[1] and increasing the store of vitamin A in the liver of the rat[2] suggests that there is an interdependence of the two vitamins which should become apparent in other ways. The failure of Bacharach[3] to confirm all Moore's work on liver storage may be due to differences in condition and relative quantities employed, Moore approximating and Bacharach missing the optimum effect. Using the United States Pharmacopeia vitamin A assay method (with olive oil as the specified "vegetable" oil in the basal diet) and *fixed* quantities of vitamin A, we have examined the effect of vitamin E over a *wide* range of dosage on the growth of young rats depleted of vitamin A. Some of the results are summarized in the accompanying graph.

Three forms of vitamin A were chosen: the pure crystalline alcohol, a crystalline ester (acetate), and mixed carotenes (90 per cent β-, 10 per cent α-). The vitamin E was a molecular distillate containing 40 per cent of mixed tocopherols,

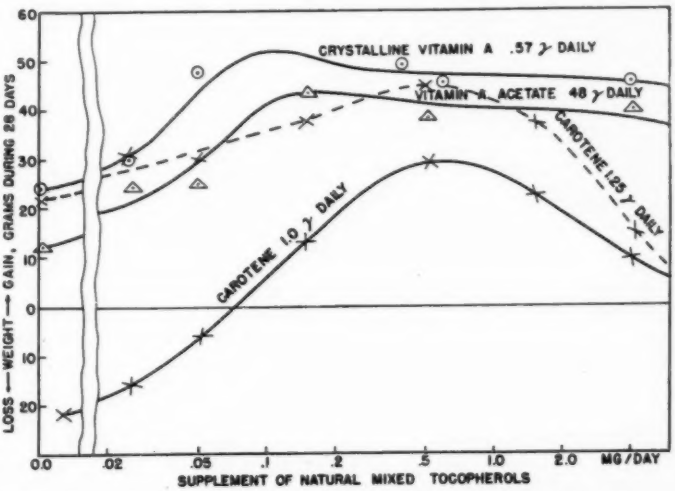
$$\left\{ \frac{E \ \frac{1 \text{ per cent}}{1 \text{ cm. } 295 \text{ m}\mu}}{0{\cdot}8} = \text{per cent tocopherols} \right\}.$$

The synergistic effect is pronounced, that with carotene striking—a quantity which was unable to support life alone, inducing good growth when fed with sufficient vitamin E. The optimum supplement of tocopherols, which is not at all critical, ranges from 0·1 mgm. daily for vitamin A to 0·5 mgm. for carotene, or about 0·6–3·0 mgm. daily per kgm. of body weight. The mutual effect persists with high levels of A intake and is most apparent when the vitamins are fed simultaneously. Feeding vitamins A and E on alternate days, or giving vitamin E during the preliminary A-depletion period, seems to diminish the effect.

Benzene extracts of the fæces of rats or humans show a small positive reaction to the Furter-Meyer and Emmerie-Engel tests. After ingestion of tocopherols, the titres are increased in excess of the quantities fed, though only part of the vitamin E activity is recoverable by bio-test. This suggests that the tocopherols have decreased the oxidation of the lipids in the G.I. tract. Considered with the data on alternate days of feeding, it is concluded that the first function of vitamin E is to preserve the vitamin A before and perhaps during intestinal absorption. A secondary effect is the preservation of vitamin A at the site of utilization in the body. Clausen[4] has shown that the transfer of vitamin A to the fœtus from the mother during pregnancy occurs chiefly through the medium of carotene. One effect of vitamin E deficiency may be the lowering of blood carotene levels in the pregnant rat below that compatible with life of the fœtus. Consequently, the anti-sterility test may be influenced by the administration of carotene and perhaps by vitamin A. A preliminary assay has furnished the following data:

Mixed tocopherols fed*	Vitamin supplement fed	Litter efficiency
1·36 mgm.	None	14 per cent
,,	,,	0 ,,
,,	Vitamin A 100 γ	14 ,,
,,	β-Carotene 300 γ	43 ,,

* In the laboratory where this assay was performed, a dose of 1·0 mgm. synthetic α-tocopherol is considered necessary to give a 50 per cent litter efficiency.



In the case of the rat on the sub-optimal A–E diet, the generalization may be hazarded that an acute shortage of either vitamin will involve deficiency symptoms of the other. Indeed, if a general function of vitamin E in animal nutrition is that of intestinal antioxidant, vitamin A may not be the only labile substance rendered more available to the body. Clinical evidence of moderate E deficiency may well be manifested in apparently unrelated deficiency symptoms.

It would seem necessary to modify the accepted methods of bio-assay of the two vitamins, retention of β-carotene as the international standard of vitamin A becoming something of a farce. A comparison of United States Pharmacopeia Reference Oil II with carotene could, by suitable juggling of the E content of the diet, show apparent potencies anywhere from 700 to 4,000 international units, the difference between the two scales becoming unimportant.

It would also seem desirable to follow the A–E synergy with animals other than rats. Studies under way with mink and related fur-bearing animals are so far positive. Should the effect be found significant with farm animals and humans, the question of preserving or supplementing vitamin E in feed will rank in importance with retaining carotene or adding vitamin A. In human nutrition the doubts as to whether a well-balanced diet can supply optimal amounts of vitamin A can be relieved by attention to the vitamin E content. Judged solely from our experiments with rats, the optimal human intake would be 50–200 mgm. mixed tocopherols daily. It seems unlikely that the diet—especially the war-restricted diet—contains these quantities. A supple-

ment of 50 mgm. would provide a total intake not far from the optimum.

The above work, to be reported fully elsewhere, is being repeated with the three pure tocopherols and extended to other animals than rats—of which, to date, about 1,500 have been used without encountering assays at variance with a positive A–E synergy.

K. C. D. HICKMAN.
P. L. HARRIS.
M. R. WOODSIDE.

(Communication No. 39)
Distillation Products, Inc.,
Rochester, New York, U.S.A.

[1] Unpublished data.
[2] Moore, T., *Biochem. J.* **34**, 1321 (1940); Davies, A. W., and Moore, T., NATURE, **147**, 794 (1941).
[3] Bacharach, A. L., *Quart. J. Pharm.*, **13**, 138 (1940).
[4] Clausen, S. W., personal communication.

Parsley as a Rich Source of Vitamin C

IT has been pointed out by Widdowson and Allington[1] that the present restriction of citrus and other fruits in the diet of the middle classes has not been compensated for by an increase in the amount of vegetables eaten, therefore the vitamin C intake has been reduced to half that consumed by the same families in 1935.

Bourne[2] has pointed out the seriousness of the situation that would arise in the event of a failure of the potato crop; although he thinks this improbable. There is no doubt that a very large percentage of the working-class population rely for their source of vitamin C upon the boiled potato, so that a partial failure of the crop with consequent local shortages would reduce the vitamin C intake to a dangerously low level.

While perhaps frank scurvy would not make its appearance, the increased liability to infection when the diet was low in vitamin C might lead to a very serious loss of working hours by workers on essential war work, especially in an epidemic.

It seems to me, that if the population cannot be induced to increase their consumption of green vegetables, the replacement of these and citrus fruits by something in the diet with a very high content of vitamin C is of importance in safeguarding the health of the public.

Apart from the pure crystalline vitamin, the choice should be something which is available, or could be made available, all the year round, and which could be easily grown by a very large percentage of the population, and, still more to the point, something with which they are familiar.

The high figure of 280 mgm. per 100 gm. has been recorded for parsley grown in India[3], 196 in South Africa[4] and 176 and 180 in America[5]. The ascorbic acid content for picked leaves of parsley grown in Cambridgeshire is shown in Table 1. The leaves were ground and extracted with trichloroacetic and metaphosphoric acid, and quickly titrated with 2 : 6-dichloro-phenol-indophenol, using the micro method of Birch, Harris and Ray[6]. Reduction by hydrogen sulphide showed no increase, and treatment by mercuric acetate[7] no decrease, in the figures obtained by direct titration.

It will be seen from Table 1 that the average of 279·5 mgm. of ascorbic acid per 100 gm. for nine different samples of English parsley is somewhat higher than the averages given by Olliver[8] for ripe black currants, and places it in the front rank of antiscorbutics. Although no biological assay has been done, Harris and Olliver[9] have confirmed the agreement between results obtained by this chemical titration method and in biological assays. It remains to be seen whether there are seasonal variations, and if the age of the leaves or the richness of the soil influences the content of the vitamin.

TABLE 1.

Date	Ascorbic acid (mgm. per 100 gm.)	Ascorbic acid (mgm. per oz.)	Water (per cent)
1942			
April 13	307·68	87·05	78·66
,, 14	250·00	70·80	77·52
,, 16	250·00	70·80	83·08
,, 17	266·40	75·55	81·08
,, 28	275·84	78·22	82·40
May 1	291·20	82·59	78·42
,, 4	291·20	82·59	80·74
,, 4	333·28	97·54	78·96
June 7	250·00	70·80	80·96
Average	279·51	79·54	80·20
Stalks April 14	66·40	18·83	85·14

The optimum amount of ascorbic acid required by an adult weighing 70 kgm. (11 stone) is about 60 mgm. a day[10], while half this amount will protect against any manifestations of scurvy[11]. It follows, therefore, that ½ oz. of parsley eaten a day will give complete protection with a diet lacking the vitamin. Unfortunately parsley is very bulky for its weight; ½ oz. of picked leaves is a small handful, but is diminished to a heaped tablespoonful by chopping.

It would be better to encourage the eating of the small picked leaves, and so preserve all the vitamin; but if the parsley is not chopped wet, and a sharp stainless steel knife is used, the loss is only of the order of 20 per cent, and there is still enough vitamin left in ½ oz. for protection. The vitamin is irreversibly oxidized by the oxidases at the cut surfaces, so the finer the parsley is chopped the greater will be the loss. After the initial loss there is no further decrease upon keeping for three hours. This has also been shown for cabbage by Pyke[12] and confirmed by Lampitt *et al.*[13].

TABLE 2.

Time after chopping	Original ascorbic acid content (mgm. per 100 gm.)	Ascorbic content after chopping (mgm. per 100 gm.)	Loss per 100 gm.
30 min.	250·00	200·00	20·0
30 ,,	250·00	210·48	15·8
30 ,,	275·84	222·00	19·5
3 hr. 0 min.	275·84	222·00*	19·5

* This sample reduced by hydrogen sulphide showed no increase.

With the growing trend to desiccate foodstuffs with a presumable loss of vitamin C, these results need emphasis. It should also be remembered that parsley is very rich in iron, containing 1·42 mgm. of available iron per oz.[14].

The crop production could easily be increased, for parsley can be grown by anyone with a garden or allotment. It is not unsightly as an edging to a flower border.

If the population could be induced to grow more

parsley and include it in their diet, it would be of great benefit to their health, and also a wise step to take. If there were a shortage of potatoes, parsley would act as a valuable source of vitamin C served with a small ration of boiled potatoes.

There are many culinary uses for parsley, and instead of the usual 'sprinkling', much more could be used. More use could also be made of it alone, or with meat, meat pastes or 'Marmite' in sandwiches. It is best to use it naturally, fresh from the garden; but in order to keep it ready for use, it should be washed, shaken to remove water and kept with the stems in water. I found no loss of the vitamin after keeping in this way for two days.

One of the best ways to use it for replacing citrus fruits is to make 'parsley lemonade' in the following simple way. Take 1 oz. of picked leaves (two handfuls) and press down in a jug; pour on to this ½ pint of boiling water and allow to stand two minutes. Now strain through a piece of muslin (or calico) and get all the parsley into the muslin, squeeze out all the liquid you can, and cool. The extract is slightly cloudy, lemon yellow in colour and contains 40–56 mgm. of ascorbic acid. This is equivalent in its vitamin content to the juice from an orange of average size. The vitamin content can be increased by using up to 2 oz. of parsley to ½ pint of water. A clear extract is obtained if the parsley is not squeezed, but it contains only about half the amount of ascorbic acid. It is not unpleasant to the palate, since there is only a slight flavour of parsley. If desired, it can be flavoured in a variety of ways to suit the taste, such as by using a lemonade preparation which has not been made from lemons.

Some typical figures obtained from 1 oz. of parsley by squeezing were 43·08, 56·80 and 51·64 mgm., and by straining only, 27·54 and 26·66 mgm.

I suggest that more parsley be used in preparing snacks and meals in canteens, British Restaurants, schools, etc.

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Proliferation-promoting Activities of Extracts from Ultra-violet Injured Yeast Cells and of Bios Components

NUMEROUS papers from these laboratories have dealt with the production of proliferation-promoting factors ('intercellular wound hormones') by cells subjected to various injuring agents. It seems warranted to believe that these substances are produced by living, injured cells as a response to injury and are not simply dead-cell disintegration products[1]. The question of the nature of these materials is of great interest. It might be assumed that they are merely normal growth substances produced or released in greater quantities under the conditions of injury, or it is possible that they represent specific 'injury substances'. Two lines of inquiry have been undertaken to answer the question: (1) chemical and spectrographic studies, which suggest a nucleic acid-like nature for the wound hormones and which definitely show that substances of this type are produced in greater quantity as a result of injury[2]; (2) comparative growth studies, on the wound hormone preparations and known growth substances. The present note is concerned with the latter.

In the earlier work assays for proliferation-promoting activity of wound hormone preparations on yeast were carried out in Reader's medium[3], an incomplete medium as judged by present standards. In experiments to be published in detail elsewhere[4] a wound hormone preparation (prepared by the full ultra-violet irradiation of a suspension of 917 gm. of Fleischmann's bakers' yeast in 10 litres of 0·85 per cent sodium chloride solution for twenty-seven hours; details in paper cited) was assayed for its effect on the proliferation of a strain of *Saccharomyces cerevisiæ*, isolated from Fleischmann's bakers' yeast, in the following media: (1) Reader's; (2) Reader's plus a bios supplement; (3) Reader's plus a bios supplement plus twenty amino acids; (4) Williams's[5]; (5) Williams's plus bios; (6) Williams's plus bios plus amino acids. The bios supplement consisted of inositol, 100 γ per c.c.; thiamin hydrochloride, 0·8 γ per c.c.; biotin, 0·002 γ per c.c.; calcium (+) pantothenate, 0·12 γ per c.c.; vitamin B_6 hydrochloride, 0·8 γ per c.c. The amino acids were asparagine, alanine, arginine, aspartic acid, cystine, glutamic acid, glycine, histidine, hydroxyproline, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tryptophane, tyrosine and valine, each in concentrations of from 0·06 to 0·48 mgm. per c.c.

Media (3), (5) and (6) gave the best growth, which represented about a 1,100 per cent increase over that in Reader's medium. The similarity of growth in media (5) and (6) is apparently due to the inclusion of asparagine in Williams's medium. The beneficial effects of the bios components and amino acids were thus quite evident. Addition of the crude wound hormone preparations in every case gave increased growth, showing that, while part of the activity of the wound hormone preparation is no doubt due to the known bios factors, a definite residual activity is due to factors other than these. This increased growth effect of the wound hormone was detectable in concentrations of the crude preparation as low as 0·5 γ per c.c.

We have now had an opportunity to extend these observations somewhat. Indications are that a large portion of the amino acid effect is due to asparagine, and we have found that the mixture of the twenty amino acids can be replaced with almost complete satisfaction by the six amino acids: arginine, asparagine, aspartic acid, glutamic acid, leucine and lysine. We have further supplemented the media with the following (in γ per c.c.): riboflavin, 1; uracil, 1; choline hydrochloride, 1·5; acetyl choline bromide, 1; ethanolamine, 5; nicotinic acid, 5. The addition of these substances seems to have no, or relatively slight, effect on the growth of our strain of yeast and they do not lessen the activity of the wound

hormone preparation. Addition of ρ-aminobenzoic acid in concentrations of 2·5 to 10 γ per c.c. did not increase the yeast crop and, in some concentrations, gave a suggestion of slight inhibition, which may not be significant.

The work may be summarized as follows: Cell-free wound hormone preparations from ultra-violet injured yeast cells maintain a considerable degree of their proliferation-promoting potency for yeast in media containing not only the required inorganic constituents and sugar but also containing amino acids, inositol, thiamin, pantothenic acid, biotin, vitamin B_6, riboflavin, uracil, choline, acetyl choline, ethanolanine, nicotinic acid and ρ-aminobenzoic acid. The wound hormone preparation therefore contains active substances in addition to these.

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Bacterial Reduction of Tetrathionate

THE power of reducing nitrate is widespread among micro-organisms, while the reduction of sulphate is restricted to a few species[1]. It has long been recognized, however, that many bacteria are able to reduce less highly oxidized inorganic sulphur compounds (tetrathionate, thiosulphate, sulphite, etc.) to hydrogen sulphide[2]. In the course of attempts to improve selective media for isolating Salmonellas and *Bact. typhosum* from excreta, we have found that, so far as some organisms are concerned, the tetrathionate is first reduced to thiosulphate. This reaction takes place rapidly and quantitatively, and estimations at different stages show that the molecular concentration of the thiosulphate formed is twice that of the tetrathionate which has disappeared, in agreement with the equation:

$$Na_2S_4O_6 + 2H \rightarrow Na_2S_2O_3 + H_2S_2O_3.$$

The subsequent further reduction of thiosulphate to hydrogen sulphide is, in comparison, so slow that the reduction of tetrathionate can be followed accurately by direct iodometric titration of the thiosulphate, provided that the high acidity developing from accumulat on of thiosulphuric acid is controlled by a phosphate buffer.

The ability to reduce tetrathionate is possessed by most of the common Salmonellas, such as *Bact. typhosum*, *paratyphosum B* and *C*, *typhi-murium*, *thompson*, *reading* and *dublin*, and by members of the Proteus group, but not by most other fæcal organisms tested including *Bact. coli*, *Bact. aerogenes* and dysentery bacilli.

Our experiments have been done almost entirely with *Bact. paratyphosum B*. The reaction can be followed in growing broth cultures, or by the use of thick washed suspensions. Unless, however, some suitable hydrogen donator such as mannitol or glucose is added to the washed suspensions, the reaction proceeds comparatively slowly. When prepared from organisms grown on plain nutrient agar, washed suspensions show an apparent lag phase before the rapid reduction of tetrathionate begins. This lag phase is not present when the organisms have been grown on agar containing tetrathionate. Suspensions grown on plain agar can be 'adapted' to reduce tetrathionate without the initial lag phase by incubation for only three or four hours with tetrathionate and mannitol, without additional source of nitrogen.

The reaction appears to be similar to other known types of anaerobic oxidation processes[3] and we have evidence that it involves a hydrogen donator (for example, glucose or mannitol), a specific dehydrogenase, a heat-stable co-enzyme-like factor present in tryptic digest broth and acting as a hydrogen carrier, a reducing enzyme mechanism, and a hydrogen acceptor (tetrathionate). The 'adaptive' effect mentioned above, taken in conjunction with the fact that tetrathionate reduction is restricted to certain organisms, strongly suggests a true acceptor specificity.

The discovery of this system is of interest from several points of view:

(1) It has brought to light certain facts of obvious importance in any attempt to explain the selective action of tetrathionate in media for isolating Salmonellas, etc.

It is significant that, in general, organisms which actively reduce tetrathionate are able to grow well in media containing it in relatively high concentration, and that, in competitive growth such as occurs in cultures from fæces, tetrathionate selects those organisms which can reduce it. The reason may be partly that the ability to reduce tetrathionate provides these with a mechanism of energy release not available to other organisms. Further, it is of interest that the substance produced in the bacterial reduction of tetrathionate is thiosulphate, which can be shown to be much less toxic than the tetrathionate from which it is formed. It is not clear, however, whether in mixed cultures this would operate entirely in favour of the tetrathionate reducers.

(2) It provides an interesting example of an oxidation mechanism of a kind known to be present in facultative anærobes[4], and especially likely to be of value to tetrathionate reducers under conditions of low oxygen tension.

(3) It affords an opportunity of investigating the important questions of acceptor specificity and enzyme adaptivity.

(4) The simple titration technique, though limited in application, is an accurate and convenient method for the study of enzyme kinetics.

It is intended to publish shortly a fuller account of this work.

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THE GAS INDUSTRY IN GREAT BRITAIN AFTER THE WAR

THE Institution of Gas Engineers held its seventy-ninth annual meeting in London on June 10, under the presidency of Sir Frederick J. West, of Manchester. The main business was the discussion of six short papers dealing with the place of the gas industry in meeting the post-war needs of Great Britain. Throughout the papers ran an emphasis on the need for greater and more thorough education of the personnel of the industry under the conditions of the future. Prof. D. T. A. Townend reviewed the development of university education since the industry applied the Livesey Fund in 1910 to endow a chair in coal gas and fuel industries in the University of Leeds. Recently the University has extended and widened the curriculum by incorporating courses in chemical engineering.

Mr. E. V. Evans, of London, vice-president, gave an account of the progress and intentions of the Gas Research Board established shortly before the outbreak of war. The gas industry of Great Britain can claim a long and effective experience in sponsoring co-operative investigations for the common good, but on a scale which was long felt to be inadequate to meet present and future needs. The new Board was devised to provide for great and necessary developments, but for obvious reasons these have been hindered by the War. Much of what has been done is of a nature which precludes publication.

To-day the most important technical question before the gas industry is the choice between carbonization and complete gasification of coal. In the future, will coal be carbonized in retorts to yield both gas and coke, or will the main product be gas only and no coke? The possibility of complete gasification of coal under pressure has been shown to be technically possible, but it remains to be shown to be commercially feasible. Success is of great national importance. The industry would be free to use almost any class of coal, free to control the amount of coke produced, and independent of imported mineral oil for the enrichment of water gas. The War has delayed the search for the answer to this problem, and much depends on the answer.

If it is shown possible to convert coal into a suitable gas without coke residue and at an acceptable price, then consumers might reach the fortunate position of those in countries with supplies of natural gas. If this quest is unsuccessful, then the industry must organize itself to supply a combination of gas and coke. The industry has already gone far to inform itself of the size of the problem. In London it has been shown from fuel bills that householders of low purchasing power need 274 therms of 'useful' heat, that is, gross heat in fuel consumed with a correction for efficiency of utilization. Mr. E. Crowther, of Newcastle, in a paper advocating the use of gas for supplying all the heat needs of householders, recorded experience with many houses specially designed and equipped for the purpose. Fuel bills show that in Newcastle the corresponding figure is 316 'useful' therms. With the tariff charges applied the total costs were of the same order as those found when the dwellings were heated by older methods.

Dr. Harold Hartley, of Birmingham, voiced the views of those who envisage the joint use of gas and coke. At present, gas is used in some measure by the great majority of householders, primarily for cooking. For space-heating its use is mainly for intermittent needs, and the bulk is supplied by solid fuels, coke yielding the cheapest service. If, however, gas were available on a two-part tariff comparable with that in the telephone service, then a very large increase in the use of gas for space-heating could be expected. For water-heating the present growth of consumption of coke will continue. It is believed that 60 per cent of domestic fuel used in Great Britain is bituminous coal, and the use of much coal is likely to continue for many years. Unless means for burning coal smokelessly can be devised, the only hope for the abatement of domestic smoke will depend on the extension of the production of gas and coke by carbonization. While there will always be some who can and will satisfy all the needs for domestic heat by electricity, Dr. Hartley thinks there will be only a limited development of the 'all electric' house. To-day the coal industry ranks first as the source of domestic heat supplies in Great Britain, but he believes that, given a suitable system of charging, the gas industry would in our lifetime attain the leading position.

The two other papers concerned more technical matters. Mr. T. C. Finlayson, of London, discussed methods for promoting efficiency and, therefore, fuel-saving in the production of gas. Dr. E. A. C. Chamberlain dealt with the same problem as it appears in the use of gas in industry—to-day enormously increased by war conditions. Gaseous fuels in furnaces offer great conveniences and possibility of fuel-saving in furnaces. This very ease of use and effortless control, however, offers a temptation to effortless and unnecessary consumption. His paper dealt with the potential savings by scientific control.

SHOOT ORGANIZATION IN DICOTYLEDON AND MONOCOTYLEDON

A PAPER by C. P. Majumdar (*Ann. Bot.*, **6**, No. 21, January, 1942) on the organization of the shoot of *Heracleum Sphondylium* leads to an interesting comparison of the mode of growth of the dicotyledon and the monocotyledon. One distinction frequently made between the two is that the leaf has a comparatively narrow insertion in the dicotyledon, and as a result room is found for two cotyledons around the embryonic apex; in the monocotyledon the leaf insertion is wide, often completely encircling the axis, and there is only one cotyledon. Two families of Dicotyledons, the Ranunculaceæ and Umbelliferæ, are characterized by unusually wide leaf insertions, and it is suggestive that all the best authenticated cases of monocotylous dicotyledons have been reported from these families.

Majumdar's examination of the development of the vegetative shoot of Heracleum directs particular attention to the effect of this wide leaf insertion upon the development and anatomy of the shoot, and once more to the remarkable 'leaf cushions' and 'bud cushions' which are one characteristic result of this feature of the umbellifer shoot. But more general interest, perhaps, is attached to the interesting analysis of the axial structure in this type, which, in spite of the multi-lacunar leaf-gap, due to the large number of trace strands entering the axis from the one wide

leaf insertion, has still the single vascular ring characteristic of the dicotyledon instead of the scattered bundle structure which would be associated with the entry of similar numerous trace strands into a monocotyledon axis. The distinction seems to be linked with the fact that in the dicotyledon the vigorous growth activity associated with the development of the leaf primordium is expressed in increase in the pro-vascular meristem. As a result the main structural features of the leaf, midrib and main veins correspond with the pattern of venation, while superficial ridges on the axis show a similar correlation with the pattern of the vascular ring. In the monocotyledon, on the other hand, both encircling leaf and subtending axis progress in size mainly by increase in the parenchymatous semi-meristem in which the pro-vascular elements are embedded. The latter keep pace with the growth of the tissues around but do not dominate it and so impress the vascular pattern on the general organization. Thus a leaf midrib, if present, may show little correlation with the course of the veins and in the axis the vascular strands lie dispersed among the ground tissue.

The author discusses how these different methods of development affect the interpretation of the shoot of dicotyledon and monocotyledon as an articulate structure, built up of coalescing 'phytons'.

FORTHCOMING EVENTS

Wednesday, July 22

INSTITUTE OF CHEMISTRY (BIRMINGHAM AND MIDLANDS SECTIONS) (at the Chamber of Commerce, New Street, Birmingham), at 6 p.m.—Prof. W. N. Haworth, F.R.S.: "Structure and Pattern in Carbohydrates".

Saturday, July 25

NUTRITION SOCIETY (JOINT MEETING WITH THE FOOD GROUP, SOCIETY OF CHEMICAL INDUSTRY) (at British Medical Association House, Tavistock Square, London, W.C.1), at 11 a.m.—Conference on "Dehydration of Foods and the Effect on their Nutritional Value".

Friday and Saturday, July 24-25

BRITISH ASSOCIATION (DIVISION FOR THE SOCIAL AND INTERNATIONAL RELATIONS OF SCIENCE) (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 10 a.m.—Conference on "Mineral Resources and the Atlantic Charter".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURESHIP IN MECHANICAL ENGINEERING—The Principal, Heriot-Watt College, Edinburgh (July 27).

LECTURER (UNGRADED) IN BIOCHEMISTRY—The Registrar, The University, Liverpool (July 30).

CHIEF ASSISTANT ENGINEER—The Clerk and Manager, West Midlands Joint Electricity Authority, Phœnix Buildings, Dudley Road, Wolverhampton (endorsed 'Chief Assistant Engineer') (July 31).

REGIUS PROFESSOR OF ENGINEERING AT EDINBURGH UNIVERSITY—The Private Secretary, Scottish House, Fieldon House, 10 Great College Street, London, S.W.1 (September 7).

MISTRESS TO TEACH MATHEMATICS (MAINLY ARITHMETIC AND BOOKKEEPING)—The Headmistress, Day Technical School for Girls, Fort Pitt, Chatham.

MASTER WELL QUALIFIED IN MATHEMATICS AND ENGINEERING SCIENCE—The Principal, Technical Institute and Junior Technical School, Gravesend.

TEACHER FOR DAY AND EVENING ENGINEERING CLASSES, and a TEACHER FOR ENGINEERING WORKSHOP PRACTICE AND METALWORK—The Principal, County Technical College, Gainsborough, Lincs.

ASSISTANT (MALE OR FEMALE) TO THE PUBLIC ANALYST—The Secretary, Health Department, Grey Friars, Leicester.

REPORTS and other PUBLICATIONS

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Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 805, Vol. 239: The Geometry of Matrices. By H. W. Turnbull. Pp. 233–267. 5*s.* Series B: Biological Sciences. No. 579, Vol. 231: The Lower Devonian Flora of the Senni Beds of Monmouthshire and Breconshire. By W. N. Croft and W. H. Lang. Pp. 131–163+plates 9–11. 8*s.* (London: Cambridge University Press.) [67

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Smithsonian Institution: United States National Museum. Bulletin 178: Catalog of the Type Specimens of Mammals in the United States National Museum, including the Biological Surveys Collection. By Arthur J. Poole and Viola S. Schantz. Pp. xiii+705. (Washington, D.C.: Government Printing Office.) 1.25 dollars. [37

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Papers from the Tortugas Laboratory. Vol. 35: The Photodynamic Action of Dyes on the Eggs of the Sea Urchin, *Lytechinus variegatus*. By David Hilt Tennent. (Publication 539.) Pp. v+153+8 plates. (Washington, D.C.: Carnegie Institution.) 1.75 dollars. [37

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Industrial Waters of Canada: Report on Investigations, 1934 to 1940. By Harald A. Leverin. (No. 807.) Pp. 112. (Ottawa: King's Printer.) [67

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